

**SITE SELECTION PROCESS
PHASE 4A: SELECTION OF
A PREFERRED SITE(S)
TRANSPORTATION**

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28 October 1985

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Site Selection Process
Phase 4A: Selection of a
Preferred Site(s) -
Transportation

Dear Sirs:

We are pleased to submit the enclosed report, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Transportation.

This volume records the results of the transportation analyses of the eight Candidate Sites that were identified during the Site Selection Process: Phase 3B.

The Technical Appendices to the Transportation Report is issued as a separate document.

Yours truly,

M.M. DILLON LIMITED


John R. Crosby, P.Eng.
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EXECUTIVE SUMMARY

PHASE 4A: SELECTION OF A PREFERRED SITE(S) TRANSPORTATION

1. PURPOSE

The purpose of the Site Selection Process Phase 4A: Selection of a Preferred Site(s) - Transportation report is to assist the Ontario Waste Management Corporation (OWMC) in developing and applying transportation-related factors to the process of selecting a preferred site(s) for special waste treatment facilities. Transportation is but one of a number of considerations involved with the site selection process which has led to the identification of a preferred site(s) as described in the report, M.M. Dillon Limited, 1985, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection, and the OWMC, 1985 Facilities Development Process, Phase 4A Report.

Phase 4A builds upon the findings of previous Phases 1, 2, and 3 reports. These earlier reports led to the identification of eight candidate sites located within the Golden Horseshoe area. One candidate site is located in the City of Mississauga, three are in the Town of Milton, two in the Township of West Lincoln, and two in the City of Niagara Falls. These candidate sites were selected because they exhibited superior potential for safely accommodating special waste treatment facilities. This report develops and applies new factors, and refines transportation

factors from Phase 3B, to assist in the systematic identification and selection of a preferred site(s) (page 1).

2. SCOPE AND METHODS

The Phase 4A site evaluation process contains four steps:

- ° factor identification and data collection,
- ° refinement of siting options,
- ° comparison of siting options, and
- ° final conclusions and recommendations.

The goals and objectives of the OWMC facilities development process were maintained in the transportation analyses carried out at each step. Public inputs gathered through the public involvement program were also utilized throughout the transportation analysis.

The inputs from all disciplines were synthesized by the site selection team as described in the report, M.M. Dillon Limited, 1985, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection, to select access roads, rail access, physical/chemical treatment plant location, and the preferred site(s).

2.1 FACTOR IDENTIFICATION AND DATA COLLECTION

These two activities were expanded and refined throughout the Phase 4A analysis (pages 10, 19). These modifications were due to additional information obtained, feedback received from the site selection team, and public inputs.

The initial transportation factors fell within the 'risk' and 'cost' factor groupings. M.M. Dillon - Transportation also supplied inputs to the 'impact' factor grouping which were used by others for factor development. Modifications to the transportation factors were made following public review, site selection team comments, and the review and analysis of transportation data (page 10).

The main sources of transportation data included roadway operating agencies, rail line operators, field surveys, and base mapping. In addition, data were also supplied to the transportation consultants through OWMC, and other consultants or sub-consultants (page 19).

2.2 REFINEMENT OF SITING OPTIONS

There were four refinements undertaken in parallel as part of this step in the overall site evaluation process (page 28):

- ° refining site boundaries,
- ° comparison of access road options,
- ° comparison of rail access options, and
- ° basic acceptability analysis.

Three of the eight candidate sites were involved in the refinement of site boundaries: LF-1E, PI-1N, and LF-3C. Although transportation inputs were considered only for site PI-1N (where the placement of the incinerator stack could have an impact on the operation of nearby Burlington Airpark), the results of the boundary refinement activities also affected the selection of local and regional access roads and rail options at these three sites (pages 29 and 77).

The comparison of access route options followed a two-stage process: preliminary Phase 4A analysis, and Phase 4A analysis (pages 29 and 83). Mainly Phase 3B factors were applied in the

preliminary analysis, and routes not eliminated at that stage were carried into the Phase 4A analysis where more refined factors and indicators were applied dealing with transport safety and road improvement costs (page 31). At each stage the transportation analysis used the factor values and their levels of importance to determine a ranking of the options (pages 31 and 114).

Rail service to a candidate site is viewed to be an opportunity rather than a requirement since it is potentially useful for the haulage of bulk shipments of process additives and reagents, but is not viewed as a requirement for facility development (pages 32 and 129). The selection of a preferred rail option involved two steps: constraint mapping, and comparative evaluation of rail access options. The constraint mapping activity used transportation inputs dealing with rail line geometric and safety constraints, as well as inputs from other consultants, to identify a number of feasible rail options to each candidate site (pages 32 and 137). The comparative analysis of the options identified led to the transportation ranking of the rail options (pages 34 and 144).

The basic acceptability analysis consisted of a review of all Phase 4A data to determine if any factor values exceeded reasonable thresholds which would deem the site unacceptable (pages 34 and 169). A review of the transportation factor values indicated that there were no transportation considerations which could eliminate a site (pages 35 and 172).

2.3 COMPARISON OF SITING OPTIONS

Two major activities were involved in the comparison of siting options (page 35):

- ° selecting a location for the physical/chemical treatment plant for partially integrated siting options, and
- ° detailed comparative analysis of the six remaining sites.

The objective of the analysis of the partially integrated siting options is to determine the optimum location for the physical/chemical treatment plant; either on the LF site (case 3) with the landfill, or on the PI site (case 2) with the incinerator (pages 35 and 173). The transportation analysis compared the two options in terms of risk to human health and the environment along the local and regional access roads due to a spill or accident involvement (pages 36 and 175). Information was also supplied to the engineering consultant (Monenco Ltd.) on the transport costs associated with each partially integrated siting option for application in the operating cost comparison (page 181).

The three remaining partially integrated siting options (case 2 operation at sites PI-1N/LF-4N, PI-13N/LF-4N and PI-27E/LF-1E) were then carried forward with the remaining integrated candidate sites (LF-3C, LF-9C and LF-1E), into the detailed comparative analysis activity (page 38).

The objective of the final activity, detailed comparative analysis, is to rank the six remaining siting options through the application of the transportation factors and indicators (pages 39 and 201). The process involves the screening, scaling, weighting and the aggregation of the indicators and factors associated with the transportation analysis. During this activity M.M. Dillon - Transportation applied the results of the generic risk assessment to the in-transit spills estimates (page 219), and aggregated a number of spill receptor indicators developed by the social, hydrogeologic and surface water consultants with appropriate transportation-related indicators and factors (page 215). M.M. Dillon - Transportation also developed and supplied data concerning impacts and costs that were then applied by other consultants in their comparative analyses (page 221).

The analyses conducted by all members of the site selection team were then synthesized by the site selection team in order to identify the major issues and trade-offs involved in the selection of a preferred site(s).

2.4 FINAL CONCLUSIONS AND RECOMMENDATIONS

Four activities were involved in this fourth and final step in the site evaluation process (page 40):

- ° review of major issues and trade-offs,
- ° final ranking of factors,
- ° final ranking of siting options, and
- ° selection of a preferred site(s).

By means of site selection team synthesis the major issues and trade-offs involved were identified for the six remaining siting options as described in the overall Site Selection report (page 40).

3. PREMISES AND POSTULATES

3.1 PREMISES

- a) Four waste scenarios were produced by OWMC for input to the transportation evaluation. All waste scenarios were based upon 300 000 tonnes per annum (t/a) of special wastes. Each scenario produced included the quantity breakdown of waste streams into 14 classes of special wastes which is an aggregation of the 79 categories used by OWMC to define special wastes (page 43).

The scenarios also provided a waste quantity breakdown by 33 municipal source areas of waste generation. This was an aggregation of the original 48 municipal waste source areas of generation used during Phase 3B.

- b) The quantity of pumpable and non-pumpable organic and inorganic wastes were identified by Monenco Limited and adopted by OWMC (page 47).
- c) The internal distribution of inbound waste and process material quantities to and between plant facilities and from process plants to landfill after treatment and/or solidification was identified by Monenco Limited and adopted by OWMC (page 47).
- d) The quantity of inbound special wastes that would be received in 200 L drums was assumed to be 3% of the total waste stream. This assumption was identified by Monenco Limited and adopted by OWMC (page 48).
- e) The possibility of using the rail mode for the bulk transport of process additives and reagents to a candidate site has been assumed by OWMC to be a siting opportunity, rather than a site requirement (page 48).

3.2 POSTULATES

- a) The truck transport mode was selected as the preferred mode for the transport of special wastes to the candidate sites. This selection was based on previous studies which cited the greater flexibility and current waste industry practices as the reasons for the selection of the truck mode (page 49).
- b) An accident risk assessment of the rail mode, which could be used to bulk haul additives and reagents to a candidate site, was not carried out since the rail service requirement to the site would be relatively light, and literature research indicated that rail-related accidents and spills involving dangerous goods are more infrequent than those involving road transport (page 50).

- c) Three basic truck types and sizes were identified and selected for the analysis of special waste transport shipments based upon the physical state of the waste and containerization requirements (page 52):
- ° pumpable wastes to be shipped in 18-tonne capacity tanker trucks with an average load size of 15 tonnes,
 - ° non-pumpable wastes to be shipped in 24-tonne capacity dump or lugger trucks with an average load size of 18 tonnes, and
 - ° drummed waste to be shipped in 9-tonne capacity flat bed or van body-type trucks with an average load size of 9 tonnes.
- d) The type and size of road and rail haul equipment assumed to be used for each of the process additives and reagents was based on current industry practice (page 52).
- e) The type and net capacity for trucks used to haul materials between sites were assumed to be as follows (page 53):
- ° solidifying wastes and slag would be shipped in 30-tonne loads using a semi-trailer dump truck from the solidification plant and incinerator respectively, to the separate landfill,
 - ° leachate would be shipped in 30-tonne loads using a semi-trailer tanker truck from the separate landfill to the PI treatment site,
 - ° pre-treated organics (oil/water) would be shipped in 30-tonne loads using a semi-trailer tanker truck from the LF treatment site to the incinerator PI site,

- ° ash would be shipped in 10-tonne loads using a 30-tonne capacity semi-trailer dump truck from the incinerator site to the solidification plant located at the LF site,
 - ° incinerator salt ash and contaminated storm water would be shipped in 30-tonne loads using a semi-trailer tanker truck from the incinerator site to the physical/chemical plant on the LF site, and
 - ° slag would be shipped in 30-tonne loads using a semi-trailer dump truck from the incinerator site to the landfill located at the LF site.
- f) The truck hauling cost rules assumed in this analysis reflect current industry pricing (1984) for the various types of vehicles likely required for use with OWMC operations as currently planned (page 55). Transport costs are estimated on a time basis (including terminal time) for return trips of less than 225 km. and on a distance basis for distances greater than 225 km. (page 57).
- g) Accident data (1980 to 1982) collected for provincial highways and regional roads were assumed to be applicable for future years based upon the historical trends in accident rates over the past 30 years (page 58). It was also assumed that the accident rate on freeway ramps will be 15% higher than the 5-year all-vehicle rate on freeways based upon previous studies. The accident rates on 'local' roadways near the site, where no accident rate data were available, would be equivalent to that of an Ontario secondary highway because these roads would be up-graded to Ontario secondary highway standards before being used to support OWMC generated trucking (page 60).

- h) The transportation model includes short connector links which represent the intra-zone travel distance from all potential waste generator sources within the municipal area. Since this travel may take place on a wide variety of roads (e.g. freeways, arterials, collectors, etc.) no representative accident rate could be assigned to these links. However, the more frequent possibility of a spill from a non-motor vehicle accident (i.e. a spill which is not a result of a motor vehicle accident) occurrence along these connector links has been included in the overall spill frequency calculations (page 61).
- i) Based on previous studies of the Ontario waste transport industry, conducted for OWMC, the conditional probability of a spill resulting from a loaded OWMC generated truck being involved in an accident was assumed to be one spill for every five loaded vehicles involved in an accident (0.196 spills/accident involvement) (page 62).
- j) Based upon an investigation of accident rates and vehicle volumes on several freeway type facilities in Ontario and the United States, it was assumed that the number of heavy trucks involved in accidents per kilometre of heavy truck travel was 2.24 times larger than the total number of all-vehicle accidents per one million all-vehicle-kilometres of travel (page 63, and Appendix J of the Transportation Technical Appendices).
- k) Previous studies of the Ontario special waste transportation industry indicate that in-transit spills, which are not related to motor vehicle accidents, occur at a rate of one spill per million vehicle-kilometres of travel by loaded trucks (page 63).

- 1) The transportation comparative analysis of candidate sites was based upon the estimated road and traffic conditions for the year 2000. To facilitate this comparison it was assumed that the present 10-year compound growth rate to years 1992 or 1993, as developed by the road agencies, would continue through the year 2000 (page 63). It has also been assumed that the effects of employee and visitor generated traffic volumes are already implicit in the growth rate developed by the various road agencies and are therefore included in the forecasts (page 65). It was further assumed that the present percentage of medium and heavy trucks observed on the access roads, identified through field studies, would remain constant to the year 2000 (page 66).
- m) A number of assumptions were made, based on Monenco Limited recommendations, regarding the plant's operation which would facilitate the noise analysis carried out by S.S. Wilson Associates subconsultants M.M. Dillon Limited (page 67):
- ° the transport of special wastes, additives, reagents, and intersite transfers as well as landfilling operations will occur within the time period 0700 to 1700 hours on normal working days,
 - ° the physical/chemical and solidification plant processes would be carried out on a one, two, or three-shift basis on normal working days depending upon the treatment demands at the time, and
 - ° the incinerator plant would operate on three shifts per day, seven days a week.

4. STATUS OF DATA

The majority of the information gathered for the transportation analyses was obtained through primary and secondary sources such as, roadway operating agencies, rail line operators, published reports, and data available from prior Phase 3B analysis.

Where possible this information was cross checked through field investigations and personal interviews. A portion of the data was obtained from other consultants on the site selection team who have carried out their own cross checking procedures.

M.M. Dillon Limited-Transportation met with the provincial, municipal and local road agencies whose roadways were included in all local and region access road options between the freeways and the site entrance, to collect information on road conditions, traffic volumes, and accident data. A cross check of this information was conducted through roadside field investigations and representative traffic counts (page 103). Similarly, railway line operators were also interviewed to discuss implications of connecting a spur line to their facilities near the candidate sites (page 136). In refining the site boundaries the consultant met with officials of Transport Canada and the owner/operator of the Burlington Airpark to discuss the implications of an incinerator stack located at site PI-1N on the Airpark's operation (page 79).

The information gathered during these early stages was also carried into the comparative analysis of the candidate sites. During this stage the transportation data were augmented with data supplied by other consultants on the site selection team. Their information on population, land uses, and environmental features were used as inputs to the transportation factors dealing with transportation spill risks along the local and regional access roads (page 188).

5. MAIN FINDINGS

5.1 REFINED SITE BOUNDARIES

The only transportation input to this analysis concerned the location of the incinerator stack at site PI-1N in relation to the nearby Burlington Airpark. The analysis concluded that the east portion of the site was free from the navigational constraints (page 82).

The refinement of the site boundaries, carried out for site PI-1N, LF-3C, and LF-1E, had implications on parallel activities: local and regional access road option comparison, rail access option comparison, and basic acceptability analysis (page 82).

5.2 PREFERRED ACCESS ROAD ROUTES

The highest ranked local and regional access route options in the transportation analysis tended to be the routes which provided lower accident rates and fewer turns, despite the higher road improvement construction costs (page 126). For all sites except LF-1E and LF-3C, the preferred transportation route was also the route preferred in the site selection team analysis. In the case of sites LF-1E and LF-3C the preferred transportation option was only slightly preferred above the option recommended by the site selection team.

Accident and cost data developed for the preferred road access route were carried into the detailed comparative analysis of siting options (page 126).

5.3 PREFERRED RAIL ACCESS ROUTE

In many cases, the rail access options to a site were equivalent in terms of transport safety. Therefore transportation rankings

were based on differences in cost (page 159). In all cases, except site LF-9C, the options which were superior in terms of transportation safety were selected as the preferred routes by the site selection team synthesis (page 167). In the case of LF-9C, the transport safety concerns of the preferred option were mitigable (road crossings).

5.4 BASIC ACCEPTABILITY

The transportation inputs to the basic acceptability analysis did not lead to the rejection of any sites, because the range in spills and accident involvements across all the options was too narrow to determine a threshold value for site rejection. However, the hydrogeologic/engineering analysis resulted in the elimination of sites LF-2N/PI-13N and LF-2N/PI-1N due to a lack of natural containment on site LF-2N (page 172). These findings are documented in the interim Phase 4A report dealing with the acceptability site LF-2N, and in the overall Site Selection report.

5.5 PREFERRED SITE FOR PHYSICAL/CHEMICAL PLANT FOR PARTIALLY INTEGRATED SITING OPTIONS

The transportation inputs to the analysis for the selection of partially integrated site operation options included the aggregation of four in-transit spill risk-related indicators developed by other consultants. Based upon the total aggregation of these transportation-related factors, it was concluded that the physical/chemical treatment plant would best be located at the PI site with the incinerator (Case 2) at sites PI-1N/LF-4N, PI-13N/LF-4N and PI-27E/LF-1E (page 197). With the latter two site options, Case 2 was strongly preferred over Case 3 (separate incinerator) operation. However, Case 2 operation at site PI-1N/LF-4N was only marginally favoured, due mainly to its lower surface water risk (page 197).

The transportation preference for a separate landfill with the physical/chemical treatment plant and incinerator at the PI site (Case 2) was confirmed following synthesis of all data by the site selection team (page 200).

5.6 RANKING OF CANDIDATE SITING OPTIONS

The transportation analysis produced a ranking of the six candidate siting options in terms of their relative transport risks. The following ranking order from most to least desirable was derived from the aggregation of the spill and accident involvement risk factors for local and regional access roads, and province-wide access routes (page 230):

- ° PI-13N/LF-4N
- ° PI-1N/LF-4N
- ° PI-27E/LF-1E
- ° LF-1E
- ° LF-9C
- ° LF-3C

The siting options in each geographic area were ranked close together. Between geographical areas the differences were larger; however, the difference between the northern sites and eastern sites was not as large as the difference between the eastern sites and the central sites.

In the analysis it was noted that the site rankings were sensitive to the importance applied to the local and regional access road study area, and the province-wide study area. The local and regional study area favoured the eastern sites (LF-PI-27E/LF-1E) and ranked the central sites (LF-3C, and LF-9C) the lowest, while the province-wide factors favoured the northern site (PI-13N/LF-4N, and PI-1N/LF-4N), and ranked the eastern sites the lowest (page 243). The overall ranking of risk factors, which gave a greater importance to the local and regional access road study area, determined the site rankings.

In terms of the total number of spills and accident involvements on the total transport system, with the facility operating at maximum capacity, only the two northern siting options display a significant statistical difference over any of the other siting options. Therefore, the preference in terms of the four remaining sites largely reflects the greater potential risks along the local and regional access roads and the greater weight attached to that factor (page 263).

The transportation analyses, with the facility operating at maximum capacity, has also demonstrated that there is very little difference among the siting options with respect to potential spills which would be hazardous to human health (9% of special wastes). Along the total transport system, the range of spills across all options would be between one every 5.1 to 7.5 years (page 237).

Similarly, the range of accident involvements where human health is affected is very small. For the total transport system, the range in the number of fatal accidents (0.9% of all accident involvements) ranges between one every 13.4 to 21.0 years. The range for personal injury accidents (30% of all accident involvements) would range between 1.6 to 2.5 accident involvements per year across all options (page 238).

5.7 SENSITIVITY ANALYSES OF TRANSPORTATION RANKING

It has been demonstrated through sensitivity analyses that although the transportation rankings are sensitive to the relative importance applied to risks on local and regional access roads and the province-wide access system the rankings would only be altered if the relative difference between the study area weights were increased two or three fold. No logical basis could be discerned to justify weighting modifications at these levels of relative difference. Consequently, the rank orders as determined were maintained (page 248).

It was also demonstrated that the transportation rankings are dependent upon the presence of certain risk receptors along the local and regional access roads; specifically population, sensitive community and recreational features, and road access. The differences among the siting options in terms of these receptors played a major role in determining the transportation rankings. The indirect risk pathways, such as sensitive hydrogeologic lands, and surface water suitability had a lesser effect on the transport rankings (page 249).

The transportation rankings were not affected by the use of rail and/or the partial solidification process. The use of rail and/or partial solidification reduced the potential transportation risks for all the siting options; however, these reductions were not significant enough to produce a change in the site rankings (page 255).

6. CONCLUSIONS AND RECOMMENDATIONS

The transportation analysis, through each of the four steps in the Phase 4A site selection process, has led to the ranking of the six candidate siting options in terms of transportation related risks.

None of the siting options failed in the basic acceptability analysis from a transportation perspective. Therefore, all of the options are acceptable in terms of transportation.

It should be noted, however, that the selection of a preferred site(s) is a multi-disciplinary process involving other risk factors, as well as cost and impact factors. The synthesis of all these inputs supplied by the site selection team will lead to the recommendation of a preferred site(s) (page 230).

The transportation analysis carried out during Phase 4A was adequate for site comparison purposes; however, subsequent analysis should consider the following transportation concerns:

- ° possible reduction in transportation risks through the use of rail for bulk hauling additives and reagents to the site, and/or the use of the partial solidification treatment process;
- ° a more detailed examination of the costs for providing adequate rail and road access to the preferred site(s) through consultation with appropriate road and rail authorities;
- ° refinement of local and regional access road/rail noise evaluation to consider the effects of existing ground contours;
- ° an investigation into the cost of bulk hauling additives and reagents to the preferred site(s);
- ° a comparison of the costs, risks, and noise impacts associated with the road and rail haulage options for additives and reagents;
- ° an investigation into the control of truck transport movements on the identified local and regional access routes;
- ° further analyses of potential risk on the province-wide access system as a result of spills and accident involvements;
- ° the development of a more detailed waste distribution scenario so that waste sources and possible routings may be better defined (Page 75); and
- ° a more detailed consideration of the likelihood of human exposure as a result of transportation events.

CHAPTER 1

INTRODUCTION

1. PURPOSE

The overall purpose of the M.M. Dillon Limited, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Transportation report is to assist the Ontario Waste Management Corporation (OWMC) in the development and the application of transportation-related factors to the process of selecting the preferred site(s) for special waste treatment facilities from the eight candidate sites selected during Phase 3B of the process. More specifically, the transportation investigations have provided direct inputs, by way of factors and indicators, to site selection within the following areas of analysis:

- ° refinement of candidate site boundaries,
- ° selection of preferred road and rail access options to each candidate site,
- ° basic acceptability of candidate sites,
- ° selection of the preferred location of the physical chemical plant at each partially integrated siting option,
- ° detailed comparative analysis of the candidate siting options.

2. BACKGROUND TO PHASE 4A

The OWMC facilities development process is being undertaken in five phases. The upper half of Figure 1.1 is a flow chart of this process.

At the conclusion of Phase 3B, eight candidate sites were considered suitable for the detailed comparative evaluation, as described in M.M. Dillon Limited., Site Selection Process, Phase 3B: Selection of Candidate Sites - Site Selection, December 1984.

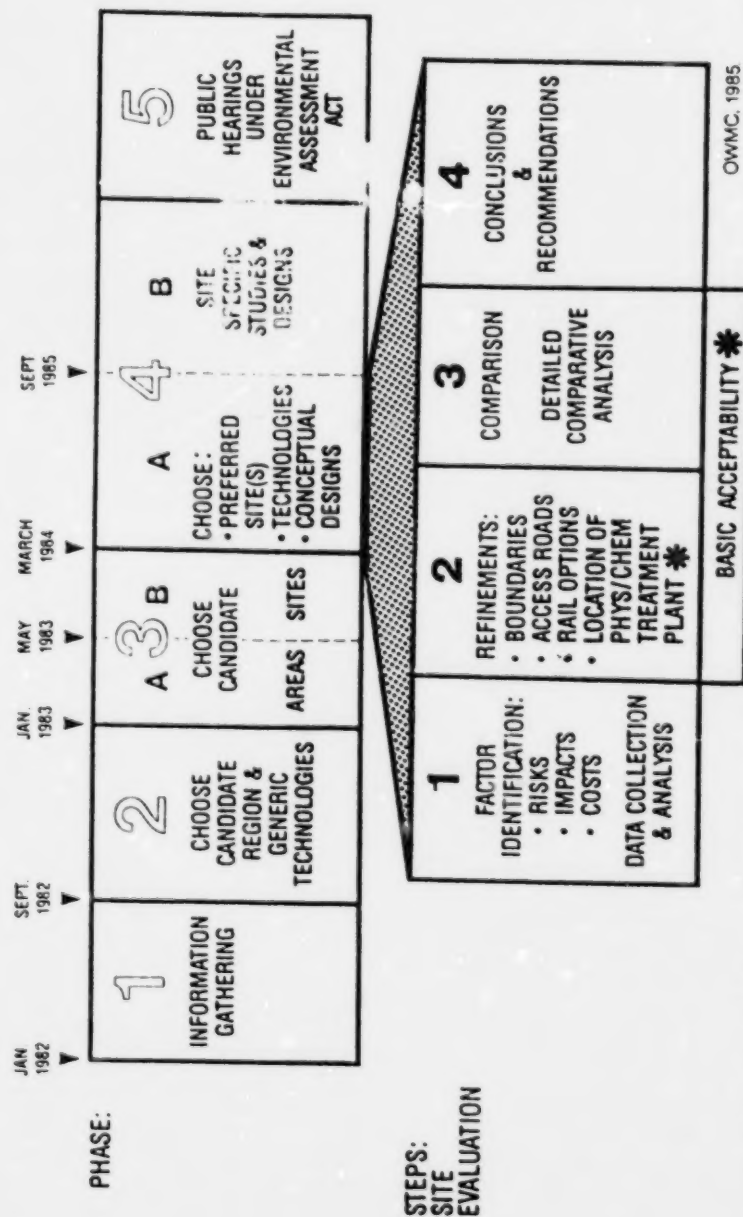
The lower half of Figure 1.1 presents a flow chart describing the four steps involved in Phase 4A of the site evaluation process leading to the selection of a preferred site(s) from the eight candidate sites.

The Phase 4A Transportation report follows from the Phase 3B report, M.M. Dillon Limited., Site Selection Process, Phase 3B: Selection of Candidate Sites Transportation, October 1984.

3. SCOPE - TRANSPORTATION ANALYSES

The transportation analyses provided inputs to the three major components of the site selection process: risks, impacts and costs. This section describes the scope of the transportation activities as they apply to each of these areas in the site selection process.

FACILITIES DEVELOPMENT PROCESS



* For purposes of the transportation analysis, to maintain consistency in the level of detail applied, "basic acceptability" was analyzed during step 2; "location of physical chemical treatment plant" was analyzed during step 3 of the comparison of siting options.

FIGURE 1.1



3.1 RISK

Transportation risk analysis was applied at various stages throughout the Phase 4A process. In the selection of preferred rail and road access routes, the transportation input to the risk component dealt with items which could affect the possibility of OWMC generated traffic (i.e. truck traffic to/from siting options) being involved in an accident event or producing a spill event. Transportation safety considerations included, historical accident frequency on access roads, existing roadway capacity and volumes, frequency of intersection turns along the routes, frequency of rail/road level crossings, and sight distance at level rail crossings. In later steps of the Phase 4A site selection process, transportation risk analysis included both the frequency of OWMC generated traffic being involved in accidents or spilling material, and the potential consequences of these events in terms of exposure to population, road users, surface water, sensitive community and recreational features, and sensitive hydrogeologic lands.

3.2 IMPACTS

The transportation analysis included the consideration of impacts of an OWMC special waste treatment facility on the surrounding environment, land use, and population. As input to the impact component, information was provided on both noise from the plant's operation, the noise level increase associated with the movement of OWMC generated traffic along the preferred local and regional access route, and the impact of the plant's incinerator stack height on the operations of nearby airfields. The amount of additional traffic generated and the noise level change were applied by other consultants to the sensitive receptors along the access routes to compare the impacts associated with the different candidate sites.

The noise level changes were calculated by S.S. Wilson and Associates, a subconsultant to M.M. Dillon - Transportation.

3.3 COSTS

The transportation analysis included estimates for the costs associated with road improvements, rail spurline construction, costs for additional land required for the selected rail and road access, and the transportation costs associated with the transport of special wastes, additives and reagents, and intersite transfers of process residues. In the selection of preferred road and rail access routes all the cost components, except for the transport cost, were applied to the option comparison by the transportation consultant. In the detailed comparative evaluation of sites, these costs were supplied to the engineering consultant (Monenco Ltd.) for input to their total cost factor.

4. APPROACH

The Phase 4A site evaluation process is outlined in Figure 1.1. Information from the factor identification and data collection activities were required in both steps 2 and 3 in the process which included a number of transportation activities. The transportation approach to each of these steps is briefly described in the following subsections.

4.1 REFINEMENT OF SITING OPTIONS

The objective of this step was to identify the candidate siting options in terms of the site boundaries, preferred rail and road access routes, and basic acceptability of sites. A number of transportation factors and indicators were developed for each activity in this step, following which the data were collected.

At the conclusion of this step, the eight refined siting options were then carried into the comparison of the siting options step of the site selection process.

The refining of the site boundaries was the first step in refinement of siting options. The transportation analysis considered the impacts of the candidate site's incinerator plant stack height and location on the operation of nearby airports during this activity.

The transportation inputs to the comparison of access road options included transport safety considerations, preliminary cost estimates for road improvements, and the area of additional land required to accommodate the road improvements.

The comparison of rail access options also considered transport safety, as well as the cost of constructing the rail spurline and the amount of additional land acquisition required.

Transportation inputs to basic acceptability analysis did not lead to the elimination of any siting options because after reviewing all the transportation data obtained in Phase 4A, it was concluded that none of it represented a situation which would warrant the rejection of a site, irrespective of its suitability for all factors.

4.2 COMPARISON OF SITING OPTIONS

Six siting options, as redefined in the second step, were carried into the siting option comparison step of the Phase 4A process. Siting options PI-13N/LF-2N, and PI-1N/LF-2N were dropped during the Basic Acceptability activity. Also site PI-13N/LF-4N was subsequently dropped as a result of the Basic Acceptability analysis; however, this did not occur until after the detailed comparative analysis.

The first activity in the third step was to identify the site on which to locate the physical chemical treatment plant for partially integrated siting options. All remaining candidate

siting options were then evaluated in the detailed comparative evaluation.

In comparing the partially integrated siting options the transportation inputs included the risk to access road users due to OWMC generated traffic involved in accidents or spillage of cargo, and the risk to population, and surface water due to spillage of material being transported to the candidate siting options.

The comparison of siting options considered transportation inputs with respect to potential accident involvement and spill frequencies on the province-wide access system excluding the local and regional access system from the 400-series highways to the candidate sites. On the local and regional access system the potential for an accident involvement in relation to potential risks to other road users was considered. The possibility for a spill occurring on this portion of the system was also considered in relation to the following:

- ° road users,
- ° population,
- ° community and recreational features,
- ° surface water suitability, and
- ° hydrogeologic sensitive land.

In addition the transportation consultant compiled data with respect to increases in traffic and noise level change on-site and along access roads impact indices, as well as road improvement and rail spurline construction cost for use by other consultants on the site selection team.

The analyses undertaken by the transportation consultant are based upon the final ranking of factors which occurred during step 4 of the process, following public review and comments. The initial detailed comparative analysis was modified to reflect these changes and various sensitivity analyses were also conducted.

5. ORGANIZATION OF THIS REPORT

This report is divided into 8 chapters dealing with the transportation approach and analyses applied in the Phase 4A site evaluation process.

Chapter 2 outlines the transportation analysis which was developed for all steps in the Phase 4A site selection process. It also presents the following information:

- ° factor identification,
- ° data collection, and
- ° transportation-related assumptions used.

Chapter 3 through 6 presents the results of the transportation analyses with regard to the following items:

- ° refining site boundaries,
- ° comparison of access road options,
- ° comparison of rail access options, and
- ° basic acceptability analysis.

Chapter 7 and 8 include all transportation analyses for the comparison of siting options activities:

- ° comparison of partially integrated siting options to determine the preferred location of the physical chemical treatment plant, and
- ° detailed comparative analysis of siting options.

Supporting data and other documentation are included in the Transportation Technical Appendices which is published as a separate document.

CHAPTER 2

METHODOLOGY

1. INTRODUCTION

This chapter describes the methodology employed during the Phase 4A four-step site evaluation process as illustrated in Figure 1.1.

The final section of the chapter, sets out the Transportation and Facility Operations assumptions employed during the Phase 4A site evaluation process to develop the transportation data requirements essential to the evaluation of siting options and the selection of a preferred site(s).

2. DESCRIPTION OF ANALYSIS AREAS

The purpose of this section is to describe the transportation analysis areas and data requirements essential to the development of this process on a step by step basis.

2.1 FACTOR IDENTIFICATION AND DATA COLLECTION

2.1.1 Factor identification

The preliminary transportation factors and indicators are displayed in Table 2.1. These factors and indicators were originally included in the OWMC publication Phase 4A Factors - 1985 which was distributed to all public groups in January, 1985.

These preliminary factors were modified as a result of M.M. Dillon - Transportation's review and interpretation of the data, inputs from the site selection team and comments received in public meetings and workshops. A number of initial modifications are presented in the OWMC publication Background Material for OWMC Phase 4A, Site Selection Workshops - Volume 1, May 1985 which was distributed prior to the OWMC Phase 4A Site Selection Workshops conducted during July 1985. That document also indicates the reasons for the factor modifications.

A final listing of transportation factors/indicators is included in Table 2.2. This listing is ordered to identify the application of factors and indicators within the OWMC goals and objectives as set out in the OWMC publication, Facilities Development Process, Phase 3 Report Appendix, March 1984. The three goals identified are as follows:

1. to minimize risk to human health;
2. to minimize environmental impacts;
3. to minimize financial costs to OWMC, and the people of Ontario.

Table 2.3 provides a comprehensive listing of all transportation factors/indicators that were developed for site

TABLE 2.1
OWMC PHASE 4A TRANSPORTATION
PRELIMINARY TRANSPORTATION FACTORS AND INDICATORS

Transportation Risk

1. Accident probability and safety of all vehicles accessing the OWMC facility (along the entire access system):
 - a) number of accidents per year
 - b) number of public intersections
 - c) peak hour volume to capacity ratio
 - d) number of level road crossings by type

2. Probability of spills from vehicles carrying special wastes to the OWMC facility:
 - a) annual number of special waste spills as a consequence of a motor vehicle accident
 - b) annual number of in-transit special waste spills non-accident related

TABLE 2.2
OWMC PHASE 4A - TRANSPORTATION
APPLICATION OF TRANSPORTATION FACTORS/INDICATORS
IN RELATION TO OWMC GOALS AND OBJECTIVES

GOAL AND OBJECTIVES ¹	TRANSPORTATION FACTORS/INDICATORS THAT APPLY
GOAL 1: TO MINIMIZE RISK TO HUMAN HEALTH	- Access system prioritized road classes: 400-series, provincial highways, designated regional arterial roads and local roads;
Transportation and Discharge - "Pathways" into the Environment. OBJECTIVES: 1. To select transportation routes and modes which minimize the likelihood of a release of contaminants during transit. 2. To site facility components so that the physical settings along the access routes to the site(s) naturally restrict the movement of contaminants and protect human health, terrestrial and aquatic ecosystems.	- Phase 4A included one factor and three indicators to optimize routings from 400-series highways to candidate sites along the local and regional access system including: FACTOR 1: Transport safety; probability of transport accidents a) Composite roadway accident rate by route. b) Number of public intersections where a turning movement is required. c) Peak hour volume to capacity ratio range along access routes.
	- Although not a requirement for site selection purposes, the rail mode was evaluated as an alternative to the road mode for transportation of process additives and reagents to minimize road exposure and impacts. One factor and two indicators were applied: FACTOR 1: Transport Safety a) Number and the class of roadway crossed by the spur line. b) Intersection/Railway crossing spacing warrant to provide mandatory signing required.
	- Phase 4A used factors for the comparison of siting options. A total of three factors were used including five indicators as follows: FACTOR 1: Transportation Safety; probability of transport accident involvement along the provincial-wide access system involving OWMC transport to and from the candidate site(s). a) The estimated annual number of OWMC generated transport vehicles involved in accidents while carrying special wastes, additives and reagents, and transferring processed wastes and residues between partially integrated sites along the province-wide access system.

TABLE 2.2
OMMC PHASE 4A - TRANSPORTATION
APPLICATION OF TRANSPORTATION FACTORS/INDICATORS
IN RELATION TO OMMC GOALS AND OBJECTIVES
(Continued)

GOAL AND OBJECTIVES¹

GOAL 1: TO MINIMIZE RISK TO HUMAN HEALTH
(continued)

GOAL AND OBJECTIVES ¹	TRANSPORTATION FACTORS/INDICATORS THAT APPLY
GOAL 1: TO MINIMIZE RISK TO HUMAN HEALTH (continued)	FACTOR 2: Transportation safety; hazard-based spill index for special waste, additive and reagent, and inter-site transport spills when hauling to or between candidate sites on province-wide access system.
	a) The hazard-based spill index for motor vehicle accident related spills for: • special waste haul vehicles; • additive and reagent haul vehicles; • inter-site transfer haul vehicles.
	b) The hazard-based spill index for non-motor vehicle accident related spills for: • special waste haul vehicles; • additive and reagent haul vehicles; • inter-site transfer haul vehicles.
	FACTOR 3: Transportation risk along local and regional access roads due to spills resulting from transportation.
	a) Road user risk index due to spills from the following OMMC generated vehicle movements: • special waste haul vehicles; • additive and reagent haul vehicles; • inter-site transfer haul vehicles.
	FACTOR 4: Transportation risk along local and regional access roads due to accident involvements resulting from transportation.
	a) Road user risk index due to the following OMMC generated vehicle movements involved in accidents: • special waste haul vehicles; • additive and reagent haul vehicles; • inter-site transfer haul vehicles.

TABLE 2.2
OMMC PHASE 4A - TRANSPORTATION
APPLICATION OF TRANSPORTATION FACTORS/INDICATORS
IN RELATION TO OMMC GOALS AND OBJECTIVES
(Continued)

GOAL AND OBJECTIVES ¹	TRANSPORTATION FACTORS/INDICATORS THAT APPLY
GOAL 2: TO MINIMIZE ENVIRONMENTAL IMPACTS	
(None of the transportation factors were developed and applied to the five objective groupings and 33 specific objectives identified.)	
GOAL 3: TO MINIMIZE FINANCIAL COST TO OMMC AND THE PEOPLE OF ONTARIO	
To minimize capital and operating costs to the greatest extent possible without sacrificing environmental quality.	
OBJECTIVES:	
1. To minimize off-site development costs, e.g. service extensions, road improvements, rail service.	- See Phase 4A Site Selection Report and other consultants' Technical Reports where other transportation - related data outputs were applied, e.g. access road impacts and site noise level change, etc.
2. To minimize transportation operations costs associated with hauling wastes and other materials to and among facility components.	- Phase 4A transportation inputs to the evaluation and selection of rail access routes to candidate sites included one cost factor and two indicators: FACTOR 1: Transportation Cost; rail spur line construction cost. a) Construction cost for a rail spur line from an existing rail line to the OMMC plant facility. b) Area of land required between the rail line and the site boundary for spur line construction.
	- Phase 4A transportation inputs to the evaluation and selection of the preferred local and regional access road system included one cost factor and two indicators. FACTOR 1: Transportation cost; road improvement costs. a) Road improvement construction cost for road platform width improvement or structural upgrading. b) Area of additional land required to upgrade roadway allowance or to realign jogged inter-sections.
	- No transportation cost factors are presented for comparison of siting options as these transport costs were direct inputs to the total cost analysis for each candidate site by the facility engineering consultant.

NOTE: 1. Complete list of objectives are contained in OMMC publication, Facilities Development Process, Phase 3B Report Appendix, March 1984.

TABLE 2.3
OUMC PHASE 4A - TRANSPORTATION
FINAL TRANSPORTATION ANALYSIS FACTORS/INDICATORS AND APPLICATION
TO THE SITE SELECTION PROCESS

Factor/Indicator or Other Transportation Outputs to Site Selection Analysis	Application of Factors/Indicators to the Site Selection Process	
	Analysis Areas ²	Consultant(s) Responsible ³
A. Transportation Safety: Probability of Transport Accidents Along Province-wide Access System Involving Truck Traffic to and from Candidate Sites		
	1. The estimated number of OUMC generated transport vehicle accident involvements in both directions along the access systems, including all vehicles transporting special wastes, additives and reagents and inter-site transfers.	- Detailed Comparative Analysis - Dillon-Transportation
B. Transportation Safety: Hazard Based Spill Index for Wastes, Additive and Reagent, and Inter-Site Transfers When Hauling to or Between Candidate Sites along the Province-wide Access System.		
	1. The estimated annual special waste, additive and reagent, and inter-site transfer hazard based spill index, as a consequence of a loaded vehicle's involvement in an accident.	- Detailed Comparative Analysis - Dillon-Transportation
	2. The estimated annual special waste, additive and reagent, and inter-site transfer hazard based spill index for loaded vehicles in- transit and associated with non-motor vehicle accidents.	- Detailed Comparative Analysis - Dillon-Transportation
C. Transportation Risk Due to Spills: Risk to Human and Environmental Receptors Along the Local and Regional Access Roads due to the Hazard Based Spill Index for the Transport of Special Wastes, Additives and Reagents, and Inter-Site Transfers		
	1. Road User Risk Index associated with the Hazard Based Spill Index.	- Detailed Comparative Analysis - Partially Integrated Siting Options - Dillon-Transportation
2. Other Receptor Risk Indices associated with the Hazard Based Spill Index and receptors, such as: population, community/recreational features, surface water suitability and hydro geologic sensitive lands.		
		- Detailed Comparative Analysis - Partially Integrated Siting Options - Dillon-Transportation Note: Receptor data provided by other consultants

TABLE 2.3
OWMC PHASE 4A - TRANSPORTATION
FINAL TRANSPORTATION ANALYSIS FACTORS/INDICATORS AND APPLICATION
TO THE SITE SELECTION PROCESS
(continued)

Factor/Indicator or Other Transportation Outputs to Site Selection Analysis	Application of Factors/Indicators to the Site Selection Process	
	Analysis Areas ²	Consultant(s) Responsible ³
D. Transportation Safety: Probability of Transport Accidents Along the Local and Regional Access Roads due to the Movement of OWMC Generated Truck Transport		
1. Composite roadway accident rate for route options.	- Local and Regional Access Route Options - Refining Site Boundaries	- Dillon-Transportation
2. Number of public roadway intersections where a turning movement is required.	- Local and Regional Access Route Options - Refining Site Boundaries	- Dillon-Transportation
3. Peak hour volume to capacity ratio range along access route options.	- Local and Regional Access Route Options - Refining Site Boundaries	- Dillon-Transportation
E. Transportation Safety: Potential Conflicts Between Road and Rail if a Rail Service Spur Line is Constructed Between an Existing Rail Line and a Candidate Site.		
1. Number and class of roadway crossed by the rail spur line option.	- Rail Access Options - Refining Site Boundaries	- Dillon-Transportation
2. Intersection/rail spur line crossing spacing required to provide adequate signage.	- Rail Access Options - Refining Site Boundaries	- Dillon-Transportation
F. Transportation Risk due to Accident Involvement: Risk to Road Users on the Local and Regional Access Roads due to the Involvement in Accidents of Trucks Carrying Special Wastes, Additives and Reagents, and Inter-Site Transfers		
1. Road Users Risk Index associated with Accident Involvements.	- Detailed Comparative Analysis - Partially Integrated Siting Options	- Dillon-Transportation
G. Access Road Impacts: The impact of the increased traffic, due to OWMC vehicles, on the receptors along the Local and Regional Access Roads.		
1. Impacts associated with the affect that the increase in average daily traffic will have on the sensitive receptors along the local and regional access routes (i.e. population, community features, agricultural vehicles).	- Detailed Comparative Analysis - Local and Regional Access Route Options - Partially Integrated Siting Options	- Ecologistics - Institute of Environmental Research Note: Dillon-Transportation provided traffic data

TABLE 2.3
OWMC PHASE 4A - TRANSPORTATION
FINAL TRANSPORTATION ANALYSIS FACTORS/INDICATORS AND APPLICATION
TO THE SITE SELECTION PROCESS
(continued)

Factor/Indicator or Other Transportation Outputs to Site Selection Analysis	Application of Factors/Indicators to the Site Selection Process	
	Analysis Areas ²	Consultant(s) Responsible ³
H. Environmental Impacts: Change in Noise Level Along Local and Regional Access Routes and at Sites		
1. The change in noise levels along the access route system from the 400-series highways to sites and between non-integrated sites as a result of truck hauling of special wastes, process additives and reagents and the transfer of treated wastes between sites.	- Detailed Comparative Analysis (Local and Regional Access Route) - Partially Integrated Siting Options	- Institute of Environmental Research Note: Dillon-Transportation provided noise data
2. The change in noise levels around the perimeter of a candidate site(s) as a result of on-site activity.	- Detailed Comparative Analysis (Site Vicinity Analysis) - Partially Integrated Siting Options	- Institute of Environmental Research Note: Dillon-Transportation provided noise data
3. The change in noise levels along a site access rail spur line that could be constructed by OWMC for the bulk hauling of process additives and reagents to a candidate site.	- Detailed Comparative Analysis (Site Vicinity Analysis) - Partially Integrated Siting Options	- Institute of Environmental Research Note: Dillon-Transportation provided noise data
I. Operations Costs: Transportation Operations Costs for Hauling of Waste and Process Materials		
1. The cost of road transport haulage of special wastes from producer source locations to a candidate site (external cost).	- Detailed Comparative Analysis - Partially Integrated Siting Options	- Monenco Note: Dillon-Transportation provided transport costing
2. The cost of road transport haulage of process additives and reagents to a candidate site (internal cost).	- Detailed Comparative Analysis - Partially Integrated Siting Options	- Monenco Note: Dillon-Transportation provided transport costing
3. The cost of road transport haulage for inter-site transfers of processed waste residuals (internal cost).	- Detailed Comparative Analysis - Partially Integrated Siting Options	- Monenco Note: Dillon-Transportation provided transport costing
J. Capital Cost: Cost of Constructing a Rail Spur Line to Serve a Candidate Site		
1. The total construction cost for a railway spur line connection from an existing rail line to the facility plant.	- Rail Access Options	- Dillon-Transportation
2. The total land area required to provide a right-of-way for construction of the rail spur line.	- Rail Access Options	- Dillon-Transportation

TABLE 2.3
ONMC PHASE 4A - TRANSPORTATION
FINAL TRANSPORTATION ANALYSIS FACTORS/INDICATORS AND APPLICATION
TO THE SITE SELECTION PROCESS
(continued)

Factor/Indicator or Other Transportation Outputs to Site Selection Analysis	Application of Factors/Indicators to the Site Selection Process	
	Analysis Areas ²	Consultant(s) Responsible ³
3. The estimated value of land acquisition for the preferred rail spur line option.	- Detailed Comparative Analysis	- Monenco - Leon Kentridge Associates Note: Dillon-Transportation provided land cost estimate based on Kentridge data
K. Capital Cost: Cost of Improving Local and Regional Access Roads		
1. The total construction cost for a new road or upgrading existing roads that are geometrically or structurally inadequate to accommodate transport vehicles, including site entrances and jog eliminations.	- Local and Regional Access Route Options - Detailed Comparative Analysis	- Monenco Note: Dillon-Transportation provided cost estimate
2. The total land area required to provide an adequate right-of-way for road widening or construction and intersectional jog eliminations.	- Local and Regional Access Route Options	- Dillon-Transportation
3. The estimated value of land required to increase roadway allowance width or to realign jogged intersections for the preferred local and regional access route option.	- Detailed Comparative Analysis	- Monenco - Leon Kentridge Associates Note: Dillon-Transportation provided land cost estimate based on Kentridge data

- NOTES: 1. Province-wide Access System does not include the local and regional access system.
2. Identification of Analysis Areas for Siting Options where factors/indicators were applied.
- a } Province-wide access system
 - b } Refining site boundaries
 - c } Comparison of local and regional access route options
 - d } Comparison of rail access options
 - e } Comparison of partially integrated siting options for location of physical chemical treatment plant
 - f } Detailed comparative analysis of siting options
3. Identification of Site Selection Consultant(s) responsible for the application of the factor/indicator to the evaluation process.
- a } Dillon - Transportation
 - b } Gartner Lee Associates - Surface Water
 - c } Ecologists - Agriculture
 - d } Institute of Environmental Research - Social Analysis
 - e } Monenco - Engineering
 - f } Leon Kentridge Associates - Land Use

selection and applied by the transportation consultant or other consultants in the overall site selection framework. This table provides the following information:

- description of factors/indicators,
- identification of factor groupings,
- identification of analysis areas to which factors apply, and
- identification of site selection consultant(s) who applied the factor during the site selection process.

The rationale for the modification of the preliminary Phase 4A factors is outlined in Appendix D.

2.1.2 Data collection

Roadway operating agencies, rail line operators and field surveys were the major sources of data for the analyses undertaken during Phase 4A, in addition to the data available from the prior Phase 3B. The OWMC and other consultants or sub-consultants provided various transportation data inputs.

Table 2.4 presents the general types of data that were collected, the sources of these data, and the stage in the process where the data were applied to the site selection process. Certain of these data were used as inputs during various steps of the process. For example, road and rail option construction costs were initially applied in the comparison of road and rail access options, respectively. Following the selection of the preferred road and rail options, by the site selection team, the costs for the preferred access options were then used in the detailed comparative analysis of the candidate sites. Some of these data are also applicable to the refining of site boundaries, and the comparison of a location of the physical chemical treatment plant at the partially integrated site operations options.

Discussion of the purpose and data analyses carried out for various steps in the process are included in the appropriate

TABLE 2.4
OWMC PHASE 4A TRANSPORTATION
DATA COLLECTION IN PHASE 4A

<u>Stage</u>	<u>Data Collected</u>	<u>Source</u>
1. Selection of Preferred Local and Regional Access Routes	° Roads	
	- accident rates on access roads	- road agencies
	- roadway geometrics	- roadway inventory sheets
	- traffic volumes and truck percentages	- field studies/road agencies
	- road realignments and additional land required	- OWMC 1:10 000 base mapping
	° Railway	
	- constraints to rail spur line routings	- OWMC 1:10 000 base mapping
2. Detailed Comparative Analysis of Candidate Siting Options	- feasibility of connection to mainline trackage	- railway agencies
	° Transportation Costs	
	- waste source areas	- OWMC market studies
	- truck load size and vehicle type	- previous studies and current practices
	- travel distance and time from source to sites	- base maps, previous studies and posted speed limits

OWMC PHASE 4A TRANSPORTATION
TABLE 2.4
DATA COLLECTION IN PHASE 4A
(continued)

<u>Stage</u>	<u>Data Collected</u>	<u>Source</u>
2. Detailed Comparative Analysis of Candidate Siting Options (continued)	° Access Road Noise	
	- ambient levels	- field investigation
	- acceptable levels of noise	- Ministry of Environment Standards
	- traffic growth factors	- road agencies
	- future OWMC generated truck traffic	- previous studies and data analysis
	° Transport Risks	
	- truck accident involvement and spill probability	- previous studies and data analysis
	- accident rates	- road agencies
	- OWMC generated truck volume	- previous studies and data analysis
	- traffic volumes on local and regional access roads and estimated growth factors	- road agencies
	° Road Improvement Requirements	
	- geometric standards	- MTC guidelines
	- capacity calculations	- MTC guidelines
	- road structural standards	- MTC guidelines
	- cost to improve roads	- Municipal benchmark costs
	- OWMC generated truck volumes	- previous studies and data analysis
	° Site Boundaries	
	- local airport conflicts	- Transport Canada - Airport Owner

report sections. Comments are also included with respect to the assumptions and the limitations of these data. Further information on the analysis framework and major assumptions is also presented in section 6 of this chapter.

a) Local and regional access route options. Data collection on the local and regional access road options involved:

- ° field survey of all route options,
- ° volume counts to determine the percent of existing heavy truck use, and
- ° agency contacts to secure physical and accident data.

Each access route option was investigated in the field through a road side field investigation. The object of this type of investigation was to uncover any information on poor road alignments, locations where extensive road improvements may be required, and to confirm the data on the municipal roadway appraisal sheets.

In addition to the field surveys, a number of traffic volume short counts were performed at various locations along the access route options in order to determine the percent of medium and heavy trucks (i.e. six or more tires) using the roadways. A summary of the information gathered at these traffic volume count locations is held on file in the M.M. Dillon Transportation consultant's office.

Various roadway agencies provided information on the site access roads under consideration. The agencies contacted included:

- ° Ontario Ministry of Transportation and Communications -
Municipal Road Office
- ° Regional Municipality of Halton
- ° Regional Municipality of Niagara
- ° Regional Municipality of Peel
- ° City of Niagara Falls
- ° Town of Milton
- ° Township of West Lincoln
- ° Town of Lincoln

The type of information which was secured from the agencies included the following:

- ° municipal roadway appraisal sheets (road geometrics, structural adequacy and road capacities, etc.),
- ° oral comments on the suitability of the various options for transporting special wastes,
- ° confirmation of deficiencies noted in the field survey,
- ° accident data on access route options,
- ° annual average daily traffic volume for each link of local and regional access routes.

The accident frequency rates used in the analysis were based on 1980 to 1982 data which was gathered from provincial and regional road agencies. This information included the number of all-vehicle accidents and annual average daily traffic (AADT) along the road sections within their jurisdiction. In all cases accident data were available for each of the years under consideration; however the AADT corresponding to the accident values was not always available. In such cases the AADT was estimated based on the historical growth trends derived from AADT's for prior years.

Information on accidents for 'local' roads was not readily available. Since these local roads were expected to be upgraded to secondary provincial highway standards, it was deemed acceptable to use the Ontario Provincial average accident rate for secondary highways, to represent these links.

To calculate the existing volume to capacity ratios of the access route option, recent information on roadway volumes and capacities was required. This information was gathered from municipal and provincial agencies wherever possible. In most cases the 1983 traffic volumes were gathered through these two sources:

- ° Municipal/Regional/Provincial roadway appraisal sheets,
- ° Traffic count data provided by roadway agencies.

Where 1983 data were not available from these sources, they were estimated from earlier traffic data by applying the road agencies' appropriate growth factors.

Similarly, roadway capacities were shown on the roadway appraisal sheets generally when the design hour volume (DHV) exceeded 800 vehicles per hour within the ten-year period, or when capacity problems existed. However, when no capacities were shown they were calculated using MTC methods. Generally, these routes had no existing capacity problems.

Most of the information required for calculating the roadway capacity was obtained directly from the roadway appraisal sheets. The percent commercial vehicle (i.e. all truck types) was sometimes available from the appraisal sheets, however, in some cases it was estimated based on the percentage for other similar type roadways in the vicinity of the specific roadway section analyzed.

b) Rail access options. Rail service to a candidate site was not viewed to be a requirement, but rather an opportunity that could be used by the OWMC for the bulk haulage of process additives and reagents required to process special wastes at the treatment site. Consequently, the lack of rail service to a site would not necessitate the rejection of the site.

The process involved collecting information for two stages in rail access selection: constraint mapping, and comparative evaluation of rail access options. The objective of the constraint mapping stage was to identify a number of viable rail access options for each candidate site. In the comparative evaluation the objective was to select a preferred rail access route.

In both stages, information was gathered from OWMC 1:10 000 scale and 1:50 000 scale maps of the candidate sites and vicinity. From the mapping the following information was obtained:

- ° location of mainline railway
- ° location of site boundaries
- ° location and type of roads to be crossed
- ° distance between rail crossings and nearest public road intersection

The following railway companies were contacted to obtain their comments on the requirements for constructing a rail spur line to connect the OWMC plant to the national line:

- ° Toronto, Hamilton and Buffalo Railway (TH & B)
- ° Canadian Pacific Railway (CP Rail)
- ° Canadian National Railway (CN Rail)
- ° ConRail

Where the railway spur line would need to cross a roadway, the road agency responsible for those roadways was contacted. The following road agencies were therefore contacted to obtain their comments on the requirements for crossing roadways with a rail spur line:

- ° Ontario Ministry of Transportation and Communications
- ° Regional Municipality of Halton
- ° Regional Municipality of Niagara
- ° Town of Milton
- ° Township of West Lincoln

During the constraint mapping stage information on the geometric and safety restriction for rail spur line routing was obtained from standards and regulation provided by Ministry of Transportation and Communications (MTC) and the Canadian Transport Commission (CTC).

c) Refining site boundaries. Sites PI-1N and LF-4N in the Milton area were identified as having a possible navigational conflict with the Burlington Airpark should an incinerator stack (60 to 100 metre height) be placed on either site. In the case of the site LF-4N the restriction contributed to the Phase 3B conclusion that no incinerator could be placed on this site.

However, for candidate site PI-1N it was noted that the east portion of the site was not subject to these navigational constraints due to a spatial separation greater than 4000 metres from the Burlington Airpark facility. The basis for the navigational constraints is the requirement that there can be no obstacles higher than 45 m above the airport's elevation within 4000 m of the theoretical centroid of the airport's landing surfaces. This requirement is documented in the report,

M.M. Dillon Limited, Site Selection Process Phase 3B: Selection of Candidate Sites - Transportation, October 1984 wherein a maximum stack height of 100 m was used. The proposed incinerator associated with the treatment facilities has a nominal stack height of 60 m as documented in the report, Monenco Limited, Status Report Facility Design, April 1985. Thus, either stack height would be in violation of the 45 m navigational constraint if located within 4000 m the Airpark.

In assessing the conflicts at site PI-1N, it was necessary to meet with Transport Canada officials to confirm the extent of the constraints in the vicinity of the sites, and secure their comments regarding an incinerator stack on site PI-1N. Also, meetings were held with the airport operator at the Burlington Airpark to receive his comments on the airport's operations, proposed facility expansion, and potential conflict with the incinerator stack. As a result of these discussions, the extent of the 45 m height restriction was plotted on the constraint mapping for site PI-1N.

d) Access road, site and rail noise. M.M. Dillon - Transportation was responsible for the definition of noise impact zones associated with the local and regional access roads, around the site boundaries and along rail access options to sites. An acoustics specialist, S.S. Wilson Associates, was retained by the transportation consultant to develop the methodology, undertake data collection, and to complete the analyses required to define the noise impact areas.

A summary of the investigations undertaken is contained in Appendix L of the Transportation Technical Appendices. A total of seven reports were produced by S.S. Wilson Associates and these are identified in that Appendix. The individual reports and accompanying exhibits are on file with the OWMC.

S.S. Wilson Associates carried out field surveys of access routes and all candidate sites. Data collection included the recording of ambient noise levels along the preferred local and regional access route system and at each candidate site. The transportation consultant provided inputs to the noise analysis so that noise impact corridors could be defined. These included the following items:

- ° existing and projected year 2000 traffic volume forecasts,
- ° existing and projected year 2000 heavy truck percentage,
- ° forecasts of OWMC generated heavy truck volumes on local and regional access routes, and
- ° estimates of rail car movements along a rail spur line for transporting process additives and reagents.

Data were also provided by Monenco Limited (engineering consultant) to the noise consultant in relation to plant equipment location and noise source generation, and operation of equipment required for the landfilling operation.

3. REFINEMENT OF SITING OPTIONS

There were four refinements undertaken in Step 2 of the overall Site Evaluation Process (see Figure 1.1). This section identifies the methodology employed and the data inputs developed for each of these refinements.

3.1 REFINEMENT OF SITE BOUNDARIES

Three of the eight candidate sites were involved in the refinement of site boundaries: LF-1E, PI-1N, and LF-3C. There were many factors considered in the refinement of these site boundaries to minimize impacts and costs to the extent possible. Transportation factors were considered for site PI-1N only.

When evaluating boundary refinement at site PI-1N, one transportation factor was considered:

- ° identification of areas within the overall site boundaries where it would be acceptable to locate an incinerator stack without conflicting with airport navigation.

The selection of the site boundaries affected the site selection processes in the following areas:

- ° selection of local and regional access routes from the 400-series highway to the site,
- ° selection of an inter-site transfer route from the site in question to its operating component site, i.e. PI-1N to LF-4N and LF-2N; and LF-1E to PI-27E; and
- ° selection of a rail access route option to the site.

The transportation factors/indicators which apply to this analysis are identified in Table 2.3.

3.2 COMPARISON OF ACCESS ROAD OPTIONS

The identification of the province-wide access routes to candidate sites was dealt with as a separate analysis. This is reported in Appendix E of the Transportation Technical Appendices. Therefore, this analysis was limited to the local and regional access route options from the 400-series highways to the candidate sites, and the inter-site transfer routes between partially integrated siting options.

The selection of the preferred access route(s) to serve the eight candidate sites followed a two-stage process. The initial stage, preliminary Phase 4A analysis, was carried out for certain of the access route options identified during Phase 3B and new routes identified by M.M. Dillon - Transportation as a result of a re-examination of access to the candidate sites. In the second stage the remaining routes plus, some new routes, were examined in more detail.

The transportation factors applied during the preliminary stage of this analysis correspond closely to those used during Phase 3B. These factors included the following:

- ° proximity to arterial roads
- ° number of level railway crossings on local and regional access routes
- ° composite accident rate
- ° proximity to 400 series highway
- ° number of intersection turns

With the exception of the composite accident rate, the information collected in the previous phase was applied directly to the preliminary analysis. However, the accident rate for regional roads and provincial highways was based on the actual annual average rate between 1980 and 1982. Since 'local' roads were expected to be upgraded as part of the OWMC facility construction to provide roads structurally and geometrically equivalent to provincial secondary highways, the provincial annual average accident rate for secondary highways was applied.

The transportation factor inputs to this initial step were then ranked and all inputs were synthesized by the site selection team with data provided by other consultants.

The remaining route options were more rigorously analyzed in the second step (Phase 4A Access Route Analysis). In addition to the route options remaining from the initial step, new local and regional access route options or inter-site transfer route options were introduced as a result of parallel work on the refinement of site boundaries (see prior discussion in section 3.1).

The access route options were then evaluated and ranked, based on two factors and five indicators:

- ° Transport Safety Factor
 - . composite annual accident rate
 - . number of public intersections where a turn is required
 - . the range in peak hour volume to capacity ratio
- ° Cost Factor
 - . road improvement construction cost
 - . area of additional right-of-way required to implement road improvements

Importance levels were assigned to each indicator and these were applied to the scaled indicator values determined for each route option. These values were then summed for each option to determine a rank order of desirability for each option. The resulting ranking of access route options from the transportation perspective was then synthesized by the site selection team.

The transportation consultant, with the assistance of S.S. Wilson Associates, also provided a preliminary definition of a noise impact corridor to be applied by the Institute of Environmental Research (IER) in the evaluation of access route options. The corridor definition and areas of application are as follows:

- ° in areas of urban development assume that all residential units up to and including the third row of houses flanking the access route could be affected by a noise level increase;
- ° in areas of sparse development or in rural areas assume that any unit up to and including 300 m from the centreline of the access route would likely be affected by a noise level increase.

It is to be stressed that this corridor definition was intended as a preliminary step in noise impact analysis and applies only to the selection of preferred access routes. A more refined analysis was applied to the preferred local and regional access route at the detailed comparative analysis stage.

3.3 COMPARISON OF RAIL ACCESS OPTIONS

Rail service to a candidate site(s), where such service is viable, is not viewed as a requirement but rather as an opportunity. Rail service is considered useful for the possible haulage of process additives and reagents which could be received in large bulk shipments at the OWMC operating plant. The rail mode has not been identified as a feasible means of transporting special waste to a centralized waste treatment facility as discussed later in this chapter, and documented in the report by Pilorusso Research Associates Inc., 1985, Transportation of Special Wastes in Ontario.

The selection of a preferred rail service option involved two steps: constraint mapping, and comparative evaluation of rail access options. The inputs of all the consultants on the site selection team were considered in both steps of the process. Constraint mapping identified a number of viable rail access options which would connect the site to a national rail line. The comparative evaluation step analyzed these options in order to select the most preferable one.

The transportation consultant prepared constraint maps for each candidate site using OWMC base mapping at a scale of 1:10 000. Information added to each site map included the rail access corridor limits from the nearby national rail line to the original Phase 3B site boundaries. The potential limits to the corridor defined at each site were based upon railway geometric controls (minimum curve radii and turnout connections to the mainline) and safety criterion.

Following the identification of rail access options during the constraint mapping stage, two impact analysis corridors were defined for purposes of data collection by all consultants. A noise impact zone of 170 m flanking each side of a rail access option was identified by the noise consultant. A second impact zone of 250 m each side of a rail service option was also selected. This was based upon information arising from a literature review and a report, Canadian Transport Commission, Railway Transport Committee, The Transport of Dangerous Commodities by Rail in the Toronto Census Metropolitan Area: A Preliminary Assessment of Risk, prepared by J. Burton and K. Post, May 1983. The 500 m corridor centred on a rail line was assumed by the authors to be a reasonable limit beyond which the impact of short-range events (explosions and fires) are less likely to have major impact.

Data collection was then initiated by all consultants for the full range of rail access options within the two corridors identified. Concurrently, the engineering consultant reviewed their facility arrangement plans for each site to provide for the integration of rail service to the plants.

During the synthesis stage, involving inputs from all consultants, a set of rail access options were defined for each candidate sites except for PI-13N and LF-2N. The site selection

team concluded that rail access to these sites produced impacts and costs which were so great that the disadvantages outweighed the advantages.

A further consideration at this point was the refinement of site boundaries. This served to eliminate certain of the rail access options from further consideration in relation to candidate site LF-1E.

All consultant inputs were then synthesized by the site selection team for the remaining rail access options leading to the selection of a preferred option. The transportation factors/indicators employed for the comparative evaluation included:

- ° Transportation Safety Factor
 - . number and class of roadway(s) crossed by the rail spur line option,
 - . intersection/rail spur line crossing spacing required to provide adequate signage in advance of the rail crossing of the roadway.
- ° Cost Factor
 - . construction cost for a railway spur line connection from the existing rail line to the plant facility,
 - . the total land area required to provide a right-of-way for construction of the rail spur line.

Subsequent to the selection of the preferred rail access option, the land use consultant provided land acquisition cost estimates for the required railway right-of-way. These cost data were then summarized for the preferred option and supplied to the engineering consultant (Monenco) for use in their analysis.

3.4 BASIC ACCEPTABILITY ANALYSIS

In previous phases of the site selection process, major transportation constraints had been considered as exclusionary.

During Phase 4A transportation-related factors/indicators were reviewed to discern if any of the siting option values exceeded reasonable thresholds and should be considered as an input to this stage of the analysis. This review included all factors developed and applied during the refinement of siting options stage and a number of factor values that had been calculated as inputs to the comparison of siting options (step 3). This review did not discern any Phase 4A transportation considerations that would contribute to the elimination of any candidate site. No threshold value for spills and/or accident involvements could be defined because the range of values across the siting options was too small.

Further discussion on the basic acceptability issues are discussed in the report, M.M. Dillon Limited, Site Selection Process, Phase 4A - Selection of Preferred Site(s): Interim Site Selection Report Candidate Site LF-2N, May 1985. Additional information is also included in M.M. Dillon Limited, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection, 1985.

4. COMPARISON OF SITING OPTIONS

This section describes the methodology employed by the transportation consultant for step 3 of the overall site selection process. Two major activities are involved as discussed in the following sections.

4.1 LOCATION OF THE PHYSICAL CHEMICAL TREATMENT PLANT FOR PARTIALLY INTEGRATED SITING OPTIONS

Following Phase 3B there were eight candidate sites producing thirteen siting options. At the completion of Step 2: Refining

of Siting Options, this was reduced to nine remaining siting options of which six were partially integrated siting options, i.e. a PI site, and an LF site operating in combination, and three integrated siting options.

The objective of the analysis of these six partially integrated siting options is to determine the optimum location for the physical chemical treatment plant; either on the LF site (case 3 operation) with the landfill, or on the PI site (case 2 operation) with the incinerator. Integrated sites (case 1 operation) are excluded from this analysis as by definition they are suitable for containing all facilities.

In terms of the transportation inputs, there were important differences between a case 2 and case 3 site operation. In a case 2 operation, all wastes and process additives and reagents would be transported to the PI site, and only transfer movements would occur between the PI and LF sites. In a case 3 operation, a portion of the wastes, and additives and reagents would be transported to the PI site (for incineration), and the remainder of wastes, and additives and reagents would be transported to the LF site (for physical chemical treatment). There is a further difference between case 2 and 3 operation in terms of the amount of processed waste by-products to be transported between the LF and PI sites.

The transportation analysis compares the differences between the two operating cases in terms of potential risk to human health and the environment along local and regional access roads due to spills and accidents. On the province-wide access system beyond the local and regional access routes, there were no differences between the two operating cases as all materials, irrespective of operating case, use the same province-wide routes, and enter the local and regional access routes at the same point.

The process of selecting the most appropriate site for the physical chemical treatment plant involved inputs from all members of the site selection team. The methodology by which all these inputs were aggregated, leading to the selection of the most suitable site for the plant, is described in the Phase 4A Site Selection Report (Dillon 1985).

The transportation consultant provided outputs from their analyses to other site selection consultants to be used in compiling their factors/indicators during this evaluation process. These factors were then applied by the team within the risk, impact and cost factor groupings.

The selected operating arrangement (case 2 or case 3) for these three partially integrated sites is then carried into the detailed comparative analysis of the siting options along with the three integrated sites remaining after step 2.

The transportation analysis was based on the potential risks to local and regional access road users due to spills and accidents. Two separate factors deal with each of these risks:

- ° risks on local and regional access roads associated with hazard-based spill index, and
- ° risks on local and regional access roads associated with accident involvements.

There was one transportation indicator associated with each of these factors which deal with the risks to the road user. Under the spill risk factor, the transportation indicator (risk to road users due to spills) was aggregated with a number of other indicators associated with risk to population, stream crossings, and sensitive community and recreation features, which were developed with data supplied by other consultants on the site

selection team. The aggregation of these spill risk indicators was an activity carried out by the transportation consultant and is documented in Chapter 7 of this report. The accident related risk factor contained only the transportation indicator, risk to road users due to accident involvements.

These factors were selected for application in this analysis because they highlighted the differences along the local and regional access road network. The other transportation factors dealing with spills and accidents beyond the local and regional routes could not discern a difference between the operating cases.

The access road impact indices were also calculated by other consultants based on the impact of an increase in annual average daily traffic on receptors along the access roads. The transportation consultant provided an input to the impact analysis based upon the estimated change in annual average daily traffic volumes for the year 2000, with and without OWMC generated truck transport traffic assigned to each link in the local and regional access system.

4.2 DETAILED COMPARATIVE ANALYSIS

Following the selection of six siting options, including the preferred location for the physical chemical treatment plant, a number of preparatory tasks were undertaken in advance of the detailed comparative analysis. This involved each of the consultants on the team and lead to the ranking and aggregation of indicators within the factor evaluation framework. This involved the following tasks:

- ° screening indicators applied to operationalize the factor,

- ° modifying factors and indicators based upon both study team and public inputs,
- ° scaling indicators, and development of a rationale for scaling levels based upon a three or five level scale,
- ° ranking indicators in order of importance within each factor,
- ° aggregating indicators within the factor and determining suitability levels attained by the factor for each siting option, and examining the sensitivity of site ranking to factor weightings.

The factors and indicators initially proposed by the transportation consultant for application to detailed comparative analysis were discussed in Section 2.1 and displayed in Table 2.1. As a result of the review and analysis of transportation data, site selection team review, and public inputs, modifications were made to various factors and indicators. The final modifications of these are presented in Table 2.3.

The indicator and factor aggregation process pertains to all transportation-related inputs to the site selection process. It is also to be noted that other consultants provided transportation-related inputs, which in turn were aggregated by the transportation consultant to produce a composite value within a factor grouping.

The transportation risk factor group aggregation was then used by the site selection study team in the detailed comparative analysis to rank sites.

The results of the detailed comparative analysis, based upon the prior discussion, was then reviewed to determine what change, if any, would occur as a result of an operational or facility process change. The following two items were considered:

- ° reduction in road transport requirements assuming that rail service is used for bulk hauling of process additives and reagents; and
- ° reduction in road transport requirements assuming partial solidification which reduces the quantity of additives and reagents, and inter-site transfer movements required.

These options were evaluated using a sensitivity analysis approach and compared to the total solidification option which assumed only road transport haulage, which was used as the basis for site evaluation, as discussed in Appendices N and O of the Transportation Technical Appendices.

Following these comparisons a further sensitivity analysis was undertaken (shown in Appendix P). This was fundamentally the linking of the rail and partial solidification opportunities. After analysis of this combination, it was compared with the basic site evaluation results to determine the extent to which the ranking of all site options would change.

5. FINAL CONCLUSIONS AND RECOMMENDATIONS

Four major activities are identified under step 4 of the Site Selection Process:

- ° final ranking of factors,
- ° review of major issues and trade-offs,
- ° final ranking of siting options,
- ° selection of preferred site(s).

Risk and impact factors were reviewed and assigned an overall level of importance based upon a ten-point scale as documented in the M.M. Dillon Ltd., 1985 report, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection. The

most important factors were assigned a value of 10, while the least important factors were assigned a value of 1, and other factors were assigned to levels 2 through 9, depending upon their individual levels of severity in terms of risk and impact. In assigning importance levels to the risk factors, preliminary information concerning public health risk was available from the generic risk assessment report prepared by Environ Corporation, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Generic Risk Assessment, 1985.

Preliminary information produced on siting issues and trade-offs, and ranking of risk and impact factors were consolidated in an OWMC public information background report, Background Material for the OWMC Phase 4A Site Selection Workshops - Volume 2, June 1985. A prior publication, OWMC, Background Material for the OWMC Phase 4A Site Selection Workshops - Volume 1, May 1985, had provided further information on the site evaluation process. These two documents provided the basic background information available to attendees at the workshops held in Hamilton, Ontario on July 12-13 and 19-20, 1985.

Workshop attendees responded to the OWMC request for comments on factor ranking and suggested a number of changes. These suggestions were then reviewed by the site selection team and appropriate modifications were adopted for the next activity in Step 4, final ranking of site options. The modifications adopted, as a result of the Hamilton workshops, are contained in the report, M.M. Dillon Limited, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection, 1985.

Final ranking of the siting options was then undertaken by all consultants using the amended factors and revised ranking of impact and risk factors. Issues and trade-offs were reviewed and updated, as necessary, in recognition of the modifications undertaken to the evaluation results.

The final activity, selection of a preferred site(s), was then undertaken based upon the results of the prior step in the process. Factors and indicators developed and employed by the transportation consultant are as discussed in Section 2.1 of this chapter and as displayed in Table 2.3.

During the final activities leading to site selection, the site selection team discerned a need for the aggregation of various factors that fall within common risk or impact groupings. Thus, the transportation consultant undertook this aggregation for the accident involvement and in-transit spill event risk factor groupings. Following this, both were integrated to produce a transportation risk input to the final ranking of siting options and recommendation for the selection of a preferred site(s).

More details on the activities involved in this step are discussed in the M.M. Dillon Ltd., 1985 report, Site Selection Phase 4A: Selection of a Preferred Site(s) - Site Selection.

6. TRANSPORTATION ASSUMPTIONS

The purpose of this section is to present the data analysis framework that was applied to develop the information requirements essential to the comparative analysis of candidate sites. This includes the premises and postulates required to undertake the analyses.

6.1 PREMISES

Premises fall within two categories:

- ° those defined by OWMC and provided to consultants, and

- ° those defined by other consultants, recommended to OWMC and accepted as assumptions to be used by other consultants.

All premises are set out and discussed under the following sections:

6.1.1 Waste scenarios

A total of four waste scenarios (Scenario 1, and the three subsets of Scenario 2) were produced by OWMC for input to the transportation evaluation. For transportation purposes the waste scenarios produced included the quantity breakdown of the waste stream into 14 classes of special waste by municipal source areas of generation. The 14 classes are an aggregation of the 79 categories used by OWMC to define special wastes. The one item common to the scenarios was that all were based upon 300 000 tonnes per annum (t/a) of special wastes.

The municipal source areas of waste generation have been redefined for purposes of Phase 4A investigations. The original 48 municipal source areas used during Phase 3B have now been condensed to 33 areas. More detailed information on this restructuring is set out in Appendix F of the Transportation Technical Appendices.

Waste Scenario 1 is perhaps best identified as a 'province-wide distribution' of Ontario waste sources, in that all areas of the Province contribute to the waste stream anticipated to be delivered at an OWMC candidate site. In this respect it was similar to the source areas of distribution used during Phase 3B transportation analysis, except that the total quantity of waste assumed to be received in Phase 3B was roughly one-half of the current quantity estimate of 300 000 t/a used for Phase 4A site selection analysis.

The ultimate design capacity of 300 000 t/a is the assumed quantity of special wastes to be treated during and following the year 2000. The initial design capacity of the OWMC facility is for 150 000 t/a, as set out in the report, Monenco Ltd., Status Report, Facility Design, April 1985.

During the initial stage of Phase 4A, Scenario 1 and Scenario 2 were analyzed to produce the following items:

- ° annual number of waste vehicles required;
- ° annual transport costs;
- ° annual accident frequency of OWMC destined special waste vehicles; and
- ° annual truck transport kilometres of travel.

Waste Scenario 2 represented the opposite extreme of the waste distribution possibilities. In this scenario it was assumed that the amount of waste attracted to the OWMC treatment facility would be sensitive to the travel distance between waste source and treatment site. OWMC selected Scenario 2 to represent the waste distribution for the purposes of site selection, although it was recognized that the most probable waste distribution would lie somewhere between these two extremes. An analysis of the transportation characteristics of these two waste scenarios is described in Appendix I of the Transportation Technical Appendices. Further discussion on Scenario 1 data and the tabulation of its geographic distribution is contained in Appendix F of the Transportation Technical Appendices.

Waste Scenario 2 was composed of three waste scenario subsets, each of which was specific to the geographical area in which the waste treatment site was located. This was done to be compatible with the three general geographic areas within which

the candidate sites are located. The subsets of Scenario 2 and the candidate site(s), and facility operating cases where these apply, are set out in Table 2.5.

Some discussion is warranted in explanation of Table 2.5. The facility operating cases were defined in the OWMC, March 1984, Facilities Development Process, Phase 3 Report, as follows:

- a) Case 1 applies to integrated sites only, wherein all processing plants and the landfill are on the same site.
- b) Case 2 applies to non-integrated sites wherein all processing plants (physical chemical/incinerator/solidification) would be located within the PI site and only landfill operation would occur on the LF site.
- c) Case 3 applies to non-integrated sites wherein the incinerator would be located within the PI site and the LF site would contain the physical chemical/solidification plant and the landfill.

These three operating cases produce different transportation requirements. Under case 1 operations all materials arrive at the candidate site, are processed and disposed at the LF site. With case 2, all materials arrive at the PI site, are then treated by physical chemical/incineration, and solidification residue is transported to the LF site for disposal. Leachate from the LF site must also be transported to the PI site with case 2 operation. Under case 3 operation, the organic wastes and certain of the process materials are transported to the PI site for incineration; inorganic wastes and the balance of process material arrive at the LF site for physical chemical treatment. Recovered organics from the physical chemical process must then be

TABLE 2.5
OWMC PHASE 4A - TRANSPORTATION
APPLICATION OF WASTE SCENARIO 2 SITE AREA GROUPINGS
TO SITING OPTIONS AND FACILITY OPERATING CASES

<u>Siting Options</u>	<u>Facility Operating Case¹</u>	<u>Scenario 2 Site Area Grouping¹</u>
LF-1E	1	Niagara Falls/ West Lincoln Area
LF-1E/PI-27E	2 & 3	Niagara Falls/ West Lincoln Area
LF-3C	1	Niagara Falls/ West Lincoln Area
LF-9C	1	Niagara Falls/ West Lincoln Area
LF-4N/PI-1N	2 & 3	Milton Area
LF-4N/PI-13N	2 & 3	Milton Area
LF-2N/PI-1N	2 & 3	Mississauga Area
LF-2N/PI-13N	2 & 3	Mississauga Area

Notes: 1. See Section 6.1.1 for discussion of "facility operating cases" and "site area groupings" by municipal areas.

transferred to the PI site for incineration, while all by-products from the incineration process are transferred to the LF site for further treatment and/or disposal.

6.1.2 Process flows

Responsibility for the development of all process quantities and types, were assigned by OWMC to a facility engineering group (Monenco Ltd.). Consequently, the material prepared by that consultant provided the process flow data used in the transportation analyses.

Specific items of information required for our analysis which were extracted from the material provided include:

- a) A breakdown in the 300 000 t/a of special wastes to be received was extracted from the Monenco Limited, 1985, Site Selection Process. Phase 4A: Selection of a Preferred Site(s) - Engineering report to provide information on organics and inorganics that are in a physical state such that they are pumpable or non-pumpable.
- b) The engineering report (Monenco 1985), provided information on the internal distribution of inbound waste and process material quantities to and between plant facilities and from process plants to landfill after treatment and/or solidification. It also provided specific information for each of the three operating cases as discussed in Section 6.1.1 of this Chapter.

Transportation information was developed for both total solidification and for the alternative disposal options (partial solidification). For purposes of site selection, the more transportation-intensive total solidification option was used.

Although partial solidification was analyzed (as reported in Appendix M of the Transportation Technical Appendices) in terms of transportation impacts and costs, only the results of total solidification were applied in the base case detailed comparative analysis of candidate sites. Partial solidification was examined by means of a sensitivity analysis and is documented in Appendices O and P of the Transportation Technical Appendices and the site selection report (Dillon 1985).

6.1.3 Drummed special waste

The assumption in the quantity of inbound special wastes that would likely be received in 200 L drums was also defined in the engineering report (Monenco 1985). The assumption was that 3% of the total waste stream would be delivered in drums. This value was applied uniformly to all wastes received including organics and inorganics both pumpable and non-pumpable.

6.1.4 Importance of rail access in site selection

The possibility of using the rail mode for the transport of process additives and reagents to a candidate site has been assumed to be a siting opportunity rather than a site requirement in the Phase 4A evaluation process. For this reason no sites were rejected on the basis of the lack of rail access, and all site comparative analysis was carried out assuming no rail access was available.

The sensitivity of the transportation analysis to this premise is documented in Appendices N and P of the Transportation Technical Appendices and is further detailed in the Site Selection report (Dillon 1985).

6.2 POSTULATES

Postulates were developed and applied by the transportation consultant which were essential to the calculation of factor and indicator values to be used in the comparison of siting options leading to the selection of a preferred site(s). This section identifies our assumptions and the rationale supporting the eight postulates.

6.2.1 Selection of a mode for transporting special wastes

Earlier investigations carried out in the report by Pilorusso Research Associates Inc., Transportation of Special Wastes in Ontario, 1983, included preliminary consideration of five modes of transporting special wastes to an OWMC treatment site. Air, pipeline and marine modes were eliminated early during this review for reasons of cost or suitability in relation to dispersion of waste generation sources within Ontario. The only remaining modes - rail and truck transport - were considered in greater detail. Truck transport was selected as the preferred mode over rail in that it provides the greatest flexibility in the following areas:

- ° distribution of waste source generation,
- ° quantities of special wastes produced by individual generators,
- ° flexibility in terms of potential for new industrial development which will produce special wastes requiring treatment,
- ° current practices now in-place within the waste treatment and waste transportation industry.

The rail mode is well suited to bulk hauling of goods and commodities especially over long distances. Given both of these attributes, rail transport is relatively safe and economically competitive, operating over a limited number of fixed routes and terminals. When these requirements of rail transport are viewed within the context of special waste hauling in Ontario, it is found that:

- ° bulking up of shipments from individual waste generators is not practical from a waste treatment viewpoint to achieve rail car loadings of up to 90 metric tonnes,
- ° few industries have storage capacity to achieve near full rail car loads,
- ° many generators lack direct rail car loading facilities,
- ° travel distances between waste source generators and the OWMC candidate treatment sites are relatively short (mean haul distance less than 100 kilometres based upon OWMC scenario 2 waste distribution).

It has not been possible to secure significant Ontario data for special waste hauling by mode of transport; however, published literature based on U.S. practises from the U.S. E.P.A. Department of Commerce, 1984 report, (NTIS, PB84-224468), Assessing the Releases and Costs Associated with Truck Transport of Special Wastes, provides some insight into this matter. The following characteristics noted from this report are based on studies carried out by others:

- ° "in the United States, 160 million metric tonnes of hazardous wastes are generated each year as part of the industrial process;
- ° 90% of all current hazardous waste transport is via the truck transport mode; and
- ° from a trip profile analysis conducted on data from several states, on average, wastes are shipped less than 100 miles from their generation to their disposal sites."

Based upon these considerations of current practice, it does not appear probable that rail transport of special wastes is viable. Consequently, road transport was selected as the most likely mode for purposes of site selection evaluation.

6.2.2 Risk assessment of rail mode

The decision not to undertake an accident risk assessment on either the proposed spur line or along the national rail line was based on the following:

- ° Rail services on the main line and spur line would be relatively light averaging 34 rail car movements per week during the tenth year of site operations (see Appendix G of Transportation Technical Appendix).
- ° Rail operational speeds along the spur line should be below 30 km per hour, therefore the severity in the event of an accident should be minimal.
- ° Recent studies, as noted in the Transport Canada report Transport Dangerous Goods, Dangerous Occurrences Reports 1981-1983, August 1984, and in the Transport Research Forum report Estimating the Risks of Transporting Hazardous Material by Rail in Canada and the United States in 1984, tend to indicate that rail-related accidents and spills involving dangerous goods are more infrequent than those involving road transport.
- ° Additives and reagent materials tend to pose a lesser risk to human health than the special wastes (Environ, 1985).

6.2.3 Transport vehicle types and sizes

Transport costing, accident frequency and transportation environmental impacts are fundamentally dependent upon the number and size of transport haulage vehicles that would be involved in the hauling of special wastes, additives and reagents from source locations to each candidate site. To determine the number of transport trucks required, assumptions must be made as to the type and size of vehicles which are likely to be used for the hauling of the required products.

There are three basic groups of vehicle types and sizes required for purposes of analysis. These fall within the following material transport requirements:

- ° vehicles to be used for the hauling of both pumpable and non-pumpable special wastes;
- ° vehicles to be used for the hauling of nine types of process additives and reagents; and

- ° vehicles to be used for the hauling of pumpable and non-pumpable process by-products which must be transported between non-integrated sites under Case 2 or 3 operations.

The selection of appropriate vehicle types and sizes to meet these three transport requirements are discussed below:

a) Special waste vehicles. Current waste treatment practice precludes the intermixing of industrial wastes at the source generation points. As a consequence, it would be difficult to achieve maximum truck capacity loadings for transporting special wastes from source generation locations to candidate sites. Thus, a conservative assumption (smaller sized shipments) was viewed to be appropriate as this would result in a greater number of truck transport movements.

Three basic truck types and sizes were identified and selected for waste transport shipments based upon the physical state of the waste and containerization method as set out below:

- ° pumpable wastes to be shipped in 18 t capacity tanker trucks with an average load size of 15 t;
- ° non-pumpable wastes to be shipped in 24 t capacity dump or lugger trucks with an average load size of 18 t, and
- ° drummed waste to be shipped in 9 t capacity flat bed or van body-type trucks with an average load size of 9 t.

b) Process additives and reagent vehicles. The nine process additives and reagents, shown in Table 2.6, that are required at the waste treatment plants are commodities commonly shipped by road or rail haul equipment. Because either mode could be used independently or in combination, it was necessary to consider container shipment size for both modes. However, it is important to note that for purposes of site selection that primary consideration was given to the road haul mode as opposed to rail hauling of these materials. Consideration was given to both

options in the event that OWMC selected rail hauling of certain bulk commodities to minimize road transport impact and possibly transport costs. The rail haul option is limited to some degree by other considerations: availability of rail service to candidate sites, and to what extent rail service could be used in relation to partially integrated sites under Cases 2 or 3 operations.

Based mainly on current industry practice, the type and size of road and rail haul equipment assumed to be used for each of the process additives and reagents is set out in Table 2.6. The decision on suitability of road versus rail hauling is based upon the annual material quantity required, as defined by the facility engineering consultant. A sensitivity analysis of the use of rail for haulage is documented in Chapter 8 of this report, Appendices N and P of the Transportation Technical Appendices, and the Site Selection report (Dillon 1985).

Table 2.6, in addition to identifying road or rail shipment sizes by material, also identifies the annual quantity of material required and the assumed shipment source point for each material. Where multiple source points were identified for these materials, we have assumed one source location in relation to all candidate sites. This applied to two materials only, and in both cases one location was identified as the most convenient source location to all candidate sites, based on the preferred route criteria.

c) Inter-site transfers. Inter-site transfer movements are required for partially integrated siting options which are assumed to operate under Case 2 (separate landfill) or Case 3 (separate incinerator) operations. With either of these, various transfers are required between sites and different vehicle types are involved depending upon the product or residue involved. In all cases the transfers are assumed to be hauled by road as this mode

TABLE 2.6
OWMC PHASE 4A - TRANSPORTATION
VEHICLE TYPE AND SIZE ASSUMED FOR TRANSPORT OF ADDITIVES
AND REAGENTS BY ROAD OR RAIL

Additive or Reagent Material	Annual Quantity (Tonnes)	Net Shipment Size For Options (Tonnes)		Assumed Source ¹ Location
		Road	Rail	
Cement	52 700	37	100	Mississauga
Sodium Silicate	21 700	31	91	Etobicoke
Chlorine ⁴	400	19	N/A	Cornwall
Sulphur Dioxide	100	19	N/A	Cornwall
Caustic Soda	6 240	31	82	Cornwall
Hydrated Lime	7 400	36	77	Toronto
Activated Carbon	100	20	N/A	Hamilton
Nitrogen ²	24 000 Nm ³	18 500 Nm ³	N/A	Scarborough
Calcium Oxide	2 380	36	82	Ingersoll

1. In the two cases where materials can be supplied from more than one location; the most appropriate site specific location was assumed. In both cases, one location was identified as the most convenient source location to all candidate sites, based on the preferred route criteria.
2. Nitrogen is required in liquid form but is measured in the gaseous state under normal atmospheric pressure.
3. Rail option is not viewed to be a viable mode where annual process quantities are relatively small. Where this occurs the symbol N/A (not applicable) is shown.
4. An alternative chemical compound (sodium hypochlorite) to liquified chlorine is being considered by the engineering consultant.

best suits the overall process needs and requirements. As PI sites are located in relative close proximity to LF sites, the flexibility provided by road hauling is much better than by rail. Also, the unit shipment size available by trucking integrates better with the process batch size requirements.

The materials to be hauled and the truck types and net capacities selected are noted below:

- ° solidifying wastes and slag would be shipped in 30 t loads using a semi-trailer dump-body truck from the solidification plant and incinerator respectively, to the separate landfill (Case 2 operation);
- ° leachate would be shipped in 30 t loads using a semi-trailer tanker type body truck from the separate landfill (Case 2 operation) to the PI treatment site;
- ° pre-treated organics (oil/water) would be shipped in 30 t loads using a semi-trailer tanker type body truck from the LF treatment site (Case 3 operation) to the incinerator PI site;
- ° ash would be shipped in 10 t loads using a 30 t capacity semi-trailer dump-body truck from the incinerator site (Case 3 operation) to the solidification plant located at the LF site, (a large vehicle volumetric capacity is required due to the low specific gravity of the dry ash);
- ° process salts and ash, and contaminated storm water would be shipped in 30 t loads using a semi-trailer tanker type body truck from the incinerator site (Case 3 operation) to the physical/chemical plant on the LF site.
- ° slag would be shipped in 30 t loads using a semi-trailer dump-body truck from the incinerator site (Case 3 operation) to the landfill located at the LF site.

6.2.4 Road vehicle transport costing

To produce estimates of transport costs for all candidate sites and operating cases, it is essential to determine a realistic costing basis that is applicable to the various transport vehicle types and sizes that were defined in the prior discussion. For

development of these costing rules, the services of Pilorusso Research Associates, Inc. were used. They have carried out extensive analysis of the for-hire transportation industry with special emphasis on the waste hauling sector as reported in their earlier work for OWMC, Pilorusso Research Associates Inc., Background Paper: Transportation of Special Wastes in Ontario, September 1983.

The truck hauling cost rules as set out in Table 2.7 reflect current industry pricing for the various types of vehicles likely required for use with OWMC operations as currently planned. These costs reflect trucking industry charges applicable during 1984 and may be subject to change over time due to many factors, e.g. labour rates, cost of equipment, operating and maintenance costs, etc. Consequently, any adjustments required to base year costs will be made by the engineering consultant in their financial analysis inputs to site selection.

Table 2.7 also includes the assumptions taken for vehicle loading and unloading times in relation to OWMC activities. These times are additive to the travel time outputs produced in the transportation model and are relevant to the costing of transport vehicle haulage which is costed on a time basis. Load and unload times are to a degree supported by data developed by Dillon and Pilorusso based upon earlier surveys carried out by each firm. The transportation consultant conducted an informal survey of vehicle types and in-plant time duration at the Tricil treatment plant during June 1984; the results of this survey are held on file with M.M. Dillon - Transportation. Earlier work for OWMC, (Pilorusso 1983), included some survey data on truck transport terminal times. However, in some instances judicious adjustment was required to reflect the special operations that would occur at an OWMC processing site. A sensitivity analysis was also carried out assuming lengthened load and unload time and is reported in Appendix G of the Transportation Technical Appendices.

TABLE 2.7
OWMC PHASE 4A - TRANSPORTATION
TRUCK TRANSPORT HAULAGE COST RATES AND ESTIMATED LOADING
AND UNLOADING TIMES FOR VARIOUS VEHICLE TYPES

<u>Haulage Requirement and Haul Vehicle Loadings</u>	<u>Bases for Costing Transport Haulage¹</u>		<u>Estimated Terminal Time (Minutes)²</u>	
	<u>Time</u>	<u>Distance</u>	<u>Loading</u>	<u>Unloading</u>
a) Waste Haulage				
15 t Pumpables	\$60/hr.	\$1.25/km	30	50
18 t Non-Pumpables	\$60/hr.	\$1.25/km	40	40
9 t drummed	\$60/hr.	\$1.25/km	40	40
b) Additives and Reagents				
6 axle semi-trailer	N/A	\$98 + \$1.40/km return	Included	Included
3-4 axle tankers	N/A	\$80 + \$1.16/km return	Included	Included
5 axle semi-van	N/A	\$46 + \$1.30/km return	Included	Included
c) Inter-Site Transfers				
30 t semi-dump for solidifying wastes, slag and ash	\$80/hr.	N/A	30	30
30 t semi-tanker for landfill leachate, treated organics, blowdown or contaminated storm water	\$80/hr.	N/A	30	30

1. Waste haulage transport costs is costed on time basis for return trips of less than 225 km and on distance basis for distances greater than 225 km.
2. Terminal times are only used when costing is made on time basis.

6.2.5 Transport vehicle accident frequency

Accident frequency calculations are required as an input to the risk factor grouping. These calculations are required to predict the probability of an accident for vehicles serving an OWMC candidate site(s). These frequency calculations are then converted to the number of truck accident involvements and a calculation is then made to estimate the number of spills that would result as an outcome of the accident events.

A second output within the risk factor grouping is the number of spills that would occur in-transit that are a result of equipment failure and are non-motor vehicle accident related.

Certain of the calculations made apply to the transport system from the material source sites to OWMC selected local and regional site access, while others relate only to the local and regional access route system from a 400-series highway to the candidate site(s). Also, the accident frequency calculations have been disaggregated so that separate frequencies were developed for the transport of special wastes, additives and reagents, and the inter-site transfer movements between non-integrated sites. Appendix K in the Transportation Technical Appendices documents the development of the accident and spill values.

To undertake the required analysis it was necessary to make certain assumptions in relation to existing data. These are identified below:

a) Roadway accident rates. As discussed in Appendix K (see Transportation Technical Appendices), four principal data sources were required to provide an adequate basis for determination of transport accident frequency data on the various links in the OWMC modelled network. To the maximum extent possible, the links used

in the model reflected the road sections used by the reporting agencies as a part of their respective Roads Needs Inventory of all Ontario roads and streets.

The most current accident rate data available were used at the time that these data were assembled for model development. As work was initiated during late 1983, the most recent published information was for the year 1982. Considering the relative stability of annual accident rates by road section over a three-year period, it was not considered necessary to revise all data to include 1983 accident rates which were not available until late in 1984.

Each of the data sources and an explanation of their application is detailed below:

i) Provincial Highways

The accident rates for each of the provincial road links was based upon the weighted average rate for the three-year period 1980 through 1982. This was the two-way rate based upon the data compiled by the Traffic Management and Engineering Department of the Ministry of Transportation and Communications.

ii) Provincial Freeway Interchange Ramps

No interchange ramp rates are published by the Ministry of Transportation and Communications. However, a special analysis was undertaken by Ministry staff on freeway ramp accidents as reported in the Pilorusso report, 1983, which indicated that approximately 15% of freeway-related accidents occur on interchange ramps.

Due to the inherent difficulty in relating ramp travel exposure as a percentage of freeway travel exposure, we have assumed that the accident rate on a freeway ramp would be 15% higher than the five-year all-vehicle accident rate on 400-series highways (1978- 1982). Any difference between the unknown true rate and the assumed rate is not viewed to be significant, because the ramp exposures (travel distance) is very small in comparison to the overall vehicle travel distance on the 400-series highways.

iii) Regional Roads

The accident rates used on the preferred local and regional access routes between the 400-series highways and candidate sites were based upon accident frequency data supplied by the respective regional road authorities, i.e. the Halton Region, Peel Region and the Niagara Region. Generally, these data covered the three-year period 1980-1982 and were based upon the total number of accidents assigned to the road links divided by the three-year annual total vehicle kilometres of travel occurring on a link. This average rate was used as a direct input to the environmental model (see Appendix K of the Transportation Technical Appendices).

iv) Local Roads

Accident data and rates are not normally available for "local roads" which include non-arterial roads within local municipalities and are normally under the jurisdiction of the second or lower tier municipality.

The use of such roadways was minimized during the selection of local and regional access routes to serve candidate sites. In many instances it was however, necessary to select a route within this category to access some but not all sites. Where this situation occurred, and considering the large number of OWMC generated vehicles that would use this roadway, it was necessary to assume an accident rate.

The physical design and structural carrying capability of local roadways was determined to be deficient in almost all instances. Thus, it was assumed that in most instances the pavement platform width must be increased as well as the load carrying capacity of these roadways.

It was therefore assumed that the improvements to these roads would result in a roadway at least equivalent to that of a secondary provincial highway. Consequently, the accident rate occurring on the newly constructed cross section should approach that of a provincial secondary highway. The five-year average accident rate for this type of roadway was assumed. The rate (1.61 accidents per million vehicle-kilometre) recorded in Table 1, Appendix K was therefore assumed for all roadways falling within the "local road" category.

v) Links Connecting Waste Centroid to
Origin Terminal (Centroid Connector)

At certain waste sources there are short connector links joining the waste source centroid to the point of entry into the transport network. The purpose of these links is to represent the intra-zonal transport of waste

materials at the source point. Since there is no indication of the type of roads on which this travel may take place, no accident rate has been assigned to these links. However, the larger possibility of a spill from a non-motor vehicle accident occurrence along these links has been included in the overall spill calculations.

The limitation involved, with respect to the centroid connector, is the determination of an accident frequency rate. Because this connector represents a multitude of possible access routes from many source generators to the centroid, it was deemed inappropriate to assume an accident frequency rate. Thus, the data output ignores the possible intra-zone accident frequency and spill frequency resulting from motor vehicle accidents on the centroid connector link.

Although this deficiency is acknowledged within the transport modeling process, it has no significant effect on the comparative evaluation and ranking of the candidate siting options. This was demonstrated by a sensitivity analysis as reported in Appendix K of the Transportation Technical Appendices.

b) Spills resulting from accidents. The Pilorusso 1983 report provides a summary of various investigations conducted by the authors and other researchers into the spill frequency of truck transport resulting from an accident. Based upon this array of findings, including the waste industry survey conducted by the authors, a spill rate of 0.196 spills for every loaded truck involved in an accident (1 spill for every 5 accident involvements while travelling loaded).

This rate is in essence a conditional probability that would be applied directly to the accident involvement frequency calculation for OWMC generated truck transport.

For purposes of comparative evaluation of siting options, this accident related spill frequency has been adopted. To apply this conditional probability for the calculation of OWMC trucking accidents, it is necessary to make a prior adjustment to the all-vehicle accident frequency rate calculation. The rationale for this conversion from the all-vehicle accident rate to a truck accident involvement rate, is as set out in Appendix J of the Transportation Technical Appendices. Thus, the adjustment factor of 2.24 was developed to make this initial conversion to which the 0.196 conditional probability is then applied.

c) Other in-transit spills. Based upon the survey data developed within the Pilorusso 1983 report investigations, other in-transit spills occur which are non-motor vehicle accident related but are due to equipment failures. The spill frequency that was determined was one in-transit spill per one million truck kilometres of travel.

This rate has also been assumed for the development of spill frequency data used in the comparative evaluation of siting options. The rate was applied directly to the calculated OWMC generated truck transport kilometres of travel for all materials travelling from material source points to a candidate site(s).

6.2.6 Access road traffic volume growth

For purpose of traffic impact analysis it was determined that all inputs to the comparative evaluation of sites should be based upon the year in which OWMC would treat 300 000 t/a of special wastes.

This is also the basis for ultimate plant design capacity and assumes that this would occur in year ten after opening of the waste treatment facilities. Based upon an assumed plant opening date of 1991, year 2000 would be the time which 300 000 t/a would be processed. This is the year used for all the following transport-related factors, indicators and inputs to others:

- ° transport costs;
- ° local and regional access road improvement requirements and costs;
- ° local and regional access road and site noise level change data provided to others by M.M. Dillon - Transportation;
- ° local and regional access road users accident involvement risk;
- ° non-motor vehicle accident spill frequency in-transit;
- ° motor vehicle accident involvement frequency and resulting spills.

To assess the impact of OWMC generated transport vehicle volumes on the access route system from the 400-series to candidate site(s), it was necessary to determine the anticipated growth in the volume of background traffic that would be using these road facilities. Background traffic is defined as the vehicle volume anticipated to occur on these roadways but excluding the truck transport volume that would be generated by an OWMC facility.

The basic data required are the growth rates established and adopted by the various roadway authorities every five years in relation to their individual Roads Needs study update. During 1984, the Ministry of Transportation and Communications and all Regional Governments inventoried their respective road systems and developed a ten-year growth factor for each link in their road system. As this factor provided an estimate of the growth in

volume to the year 1993, it was necessary that M.M. Dillon - Transportation develop and extend the estimated volume to cover the seven-year period 1994 to 2000.

A conservative approach was adopted for purposes of this forecast. It assumed that the compound annual growth rate forecasted for the ten-year period would continue to be applicable for the remaining seven-year period. Consequently, the annual compounded growth rate was applied for the 16-year period to the actual 1984 annual average daily traffic (AADT) to estimate the year 2000 AADT on each of the appropriate road links or sections. This approach likely over-estimated the future AADT, in that the normal tendency is for the compound growth rate to decrease over time.

Forecasting of year 2000 AADT's on the 'local roads' used the same fundamental approach, although the application was somewhat different due to existing limitations. Road Needs Studies on these routes are not scheduled for completion until later during 1985. It was therefore necessary to use the most recent data (normally the year 1980 update) which included a 1980 to 1990 growth factor. The annual compounded growth rate for this ten-year period was then applied to the most recent AADT and this was extrapolated to the year 2000.

Employee and visitors to an OWMC facility site will add traffic volume to various roadways in and around the site. As the home base for this additional generated traffic is an unknown, it is impractical at this time to determine the routings to be used and to calculate the increase in traffic volumes on these routes. Consequently, it has been assumed that the effects of employment and visitation generated traffic volumes are already implicit in the growth rates developed by the various road authorities over the forecast period. Thus, no additional adjustment was required to account for these movements.

6.2.7 Percentage of heavy truck traffic

Roads Needs Studies also give consideration to the number of commercial vehicles that are using a road section. These are largely estimates obtained from vehicle classification counts taken on roadways or at intersections during relatively short time periods, e.g. four, six, eight or ten-hour periods. In many instances these commercial registered vehicles include light trucks, such as pick-up and small vans. In terms of vehicle operations and axle loadings there is little difference between these light trucks and standard pleasure vehicles. From a pavement structural requirement viewpoint, there is little or no difference between these vehicle types. The more important grouping of commercial vehicle is the medium and heavy truck group which apply heavy axle loadings to the pavement structure. As the percentage and the actual number of vehicles within this group increases, there is a requirement to increase the depth and strength of the road pavement structure to carry these more frequent heavy axle loadings.

A secondary consideration is that as the percent of medium and heavy trucks increases the pavement platform width required must also be increased. This affects both the width of pavement and shoulders required.

Because of the overall importance of the number of medium and heavy trucks using a roadway section in relation to the physical design and construction, the transportation consultant undertook vehicle classification counts on all road sections that may be subject to OWMC generated heavy truck loadings. These counts were made during summer 1984. Two four-hour weekday counts were made along each road section. The counts included the total vehicle movement, and the number of trucks having six or more tires, which we assumed to be the lower end of the medium truck size grouping. From these data a heavy-truck percentage was then calculated.

For purposes of our analysis the resulting medium and heavy truck group percentage was then applied to the year 2000 AADT forecast of total vehicles, to determine the number of medium and heavy trucks that would occur as a part of total background traffic on each road link. Our assessment of the impact of a decision to locate an OWMC facility within the various candidate areas was then based on this result. The underlying decision was whether or not the addition of OWMC generated traffic to the background truck traffic and total traffic volume would result in a new pavement design threshold which would affect road improvement capital and maintenance costs over the period. The significance of this change is viewed to be more important on lightly used roads carrying low truck volumes as opposed to heavily used roadways with an existing high truck volume.

6.2.8 Traffic and site operation noise

To permit the analysis of noise impacts as a result of OWMC operation at each of the candidate sites or siting combinations, two study areas were defined: along local and regional access routes and around the perimeter of each site operating combination.

The methodology and results of the noise analysis, and all reference documents are contained in Appendix L of the Transportation Technical Appendices. The following data are important inputs to access road and site noise calculations:

- ° additional heavy truck movements as a result of OWMC operation;
- ° time of occurrence of these truck movements;
- ° location of the facility treatment plants within candidate sites and the location of noise generating equipment within the plant areas; and

- time of operation of the various treatment plant operations.

Several assumptions were made with regard to operations by the engineering consultant (Monenco 1985), as follows

- a) The transport of special wastes, additives and reagents, and inter-site transfers where applicable, will occur during one day-time work shift within the time period 0700 to 1700 hours on normal working days. Also, the landfilling operation for solidifying treated waste would occur within this same period.
- b) The physical chemical and solidification plant processes would be carried out on a one, two or three-shift basis on normal working days depending upon the treatment demands at the time. For example, at a process demand of 300 000 tonnes per annum, it would operate three shifts per day and 5 days per week.
- c) The incinerator plant would operate on an around-the-clock basis except when shutdown for routine or extraordinary maintenance purposes. This involves three shifts per day and seven days per week operation for a total of 7 000 hours per year when 300 000 tonnes per annum of wastes are processed.

These time periods were used for all noise analysis work as detailed in Appendix L of the Transportation Technical Appendices.

6.3 LIMITATIONS

The basic postulates and premises, as per previous discussions, are viewed to be reasonable and prudent inputs to the overall site comparison and selection to be conducted during Phase 4A of this

process. In the main, these assumptions are viewed to be a conservative approach; that is, they will tend to over estimate rather than to under estimate the cost, impacts and risks associated with the facility. The assumption of the use of total solidification is compared to the use of partial solidification in Appendices O and P in the Transportation Technical Appendices. Partial solidification reduces the vehicle transport requirements.

One perceived limitation is worthy of broadened discussion. This relates to the use of accident frequency rates based upon historical data (1978 to 1983 time period) with an application to OWMC generated trucking operations during the assumed year 2000. Three questions arise which are pertinent to the use of these rates:

- ° With changes in the road system and vehicle use, do the accident rates reflect those that will exist for the year 2000?
- ° Do the all-vehicle accident rates for each road section properly reflect the expected frequency of OWMC generated heavy truck vehicle accidents?
- ° Will all OWMC generated truck transport movements to candidate sites follow the identified preferred access routes?

These questions all relate to the risk factor grouping and the most highly ranked goal of OWMC, to minimize risk in the site selection process. Although transport risk is but one factor, it is important that the site selection analysis provides an accurate portrayal of the 'real world' events. Discussion of the background considerations in relation to these questions and their sensitivity is set out below.

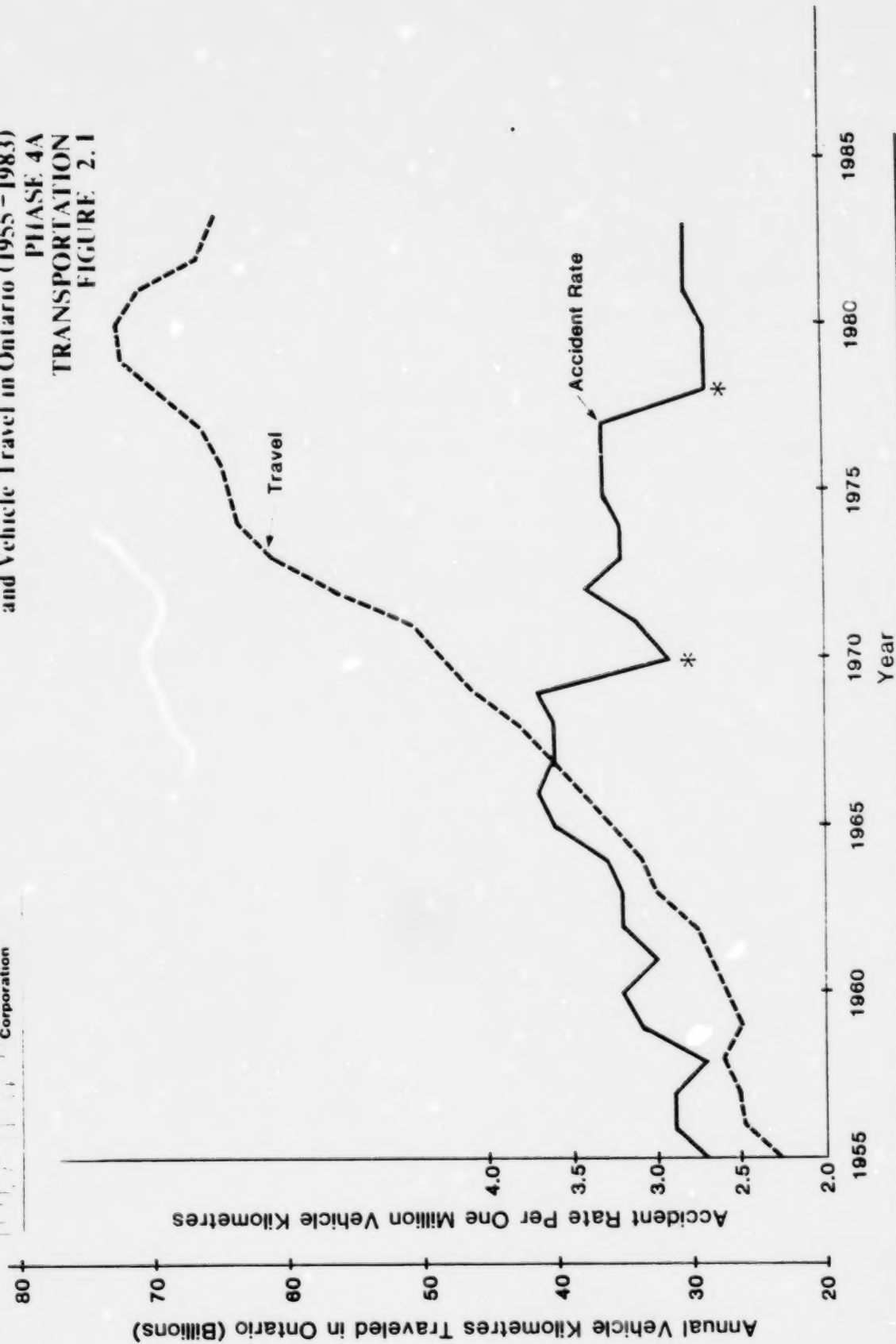
6.3.1 Accident frequency rates

The source documentation used for this investigation are the annual publications of the Planning Division, Ministry of Transportation and Communications, 1971 Traffic Volumes and Collision Rates and Provincial Highways, Traffic Volumes 1983, June 1984. These documents include the publication of annual accident rates by various road types. As our analysis includes roadways within all categories, we have selected the published rates for 'all Ontario' for this investigation.

Figure 2.1 presents a plot of the all-vehicle accident rate for all Ontario roads. The rates per annum are based upon the total number of accidents per one million vehicle kilometres of travel occurring each year over the 29-year period 1955 through 1983. The total vehicle kilometres of travel on Ontario roadways is also recorded on this figure as a benchmark for comparison with the annual accident rates.

It is noted from the plot that the annual accident rate has remained relatively stable over the entire time period with the current rates, over the last six years, remaining basically the same as over the 1955 to 1958 period. From 1959 to the 1966-69 period the frequency rate increased, then declined over the period through 1978. Certain of the accident rate variations may be explained in relation to the definition of a 'reportable motor vehicle accident'. This has varied over time as it relates to the monetary value of damage incurred in an accident. Prior to 1970, only accidents involving \$150 damage or more required reporting. In 1970 this was increased to \$200 damage and this increased to \$400 in 1978. When these dates are considered when reviewing the data plot, it is noted that the increase in damage reporting requirement coincides with a rather dramatic reduction in rates. The periodic increase in reportable property damage accident

Historical Trends of Accident Frequency Rates and Vehicle Travel in Ontario (1955 - 1983) PHASE 4A TRANSPORTATION FIGURE 2.1



*Denotes year in which property damage value changed defining a reportable motor vehicle accident.



values (from \$150 to \$400) fails to even keep pace with the consumer price index (CPI) which doubled within the period 1975 to 1983 alone. Had the value of a reportable accident property damage accident been indexed to the CPI on a constant dollar basis, the accident rate trend would have been downward throughout the entire period.

It is also interesting to note that the vehicle kilometres of travel has been consistently increasing at a compound annual rate of 3.65%. The actual growth factor between 1955 and 1983 was 2.83. Thus, even with this consistent growth in travel (exposure), the accident rate has remained relatively static.

Consequently, we are of the opinion that the use of accident rates during the later 1970's and early 1980's is realistic in the forecasting of OWMC related vehicle accidents for the year 2000.

6.3.2 Truck accident rates

Little empirical data exists on accident rates by vehicle type due mainly to the lack of exposure (vehicle-kilometres of travel) data for the various vehicle types. The Pilorusso 1983 report compiled data suggesting that large trucks may be involved in accidents less frequently than other vehicle types. This conclusion was not supported by our experience. To resolve this matter and recognizing the lack of appropriate data in the Ontario database, several possible surrogates were identified and analyzed to develop appropriate information to deal with this matter. The results of this analysis and a discussion of its application are presented in Appendix J of the Transportation Technical Appendices.

In summary, the New Jersey data proved to be most consistent with the Ontario accident experience. From this surrogate we determined the following information:

- ° all-vehicle involvement rate is 1.635 times the all-vehicle accident rate, and that the
- ° heavy truck involvement rate is 1.37 times the total all-vehicle accident involvement rate.

Thus, the combination of these two conversion factors ($1.37 \times 1.635 = 2.24$) is the appropriate factor to be applied to the Ontario all-vehicle accident rates to arrive at the number of OWMC generated truck movements that would be involved in accidents over a period of one year.

Many researchers involved in accident research are now using the term motor vehicle involvement rate as opposed to accident rate, e.g. Michael Freitas, A Review of Accident Research Involving Truck Size and Weight, Public Roads, September 1982. A common example used is: if a car and a truck collide, is it a car accident or a truck accident? Or both? When comparing the relative safety of various vehicle types this distinction is important. Thus, an accident involving four vehicles would be counted as four vehicle involvements and each involvement may be categorized by the vehicle types involved, for example, if the four-vehicle accident involved one bus, one truck and two passenger cars, there would be one involvement each for a truck and a bus and two passenger car involvements.

As our risk indicator is defined as the annual number of OWMC generated heavy truck accident involvements, we have used the conversion factor of 2.24 times the all-vehicle accident rate to produce an estimate of the annual number of truck accident involvements per one million truck kilometres of travel.

6.3.3 Truck routings/access routes

The local and regional access route investigations conducted by all consultants dealt only with those routes which are viewed as primary routes from the 400-series highways to each candidate site. It was recognized that in some instances a 400-series highway is not conveniently located with respect to source sites of special wastes and an OWMC candidate site. Also, there is a very broad scattering of individual waste source producers within a municipal area special waste generation zone or area. Consequently, some waste movements are better served via other access routes as opposed to the selected preferred access from the 400-series highways.

During the transportation modelling phase of our analysis, which involved the assignment of special waste hauling vehicles to the Ontario road network, the use of other routes was confirmed. This situation was detected to occur in relation to the sites located in West Lincoln and the Niagara Falls area. With the location of the QEW skirting the north and eastern perimeter of the peninsula, many source areas of waste generation are actually closer to the candidate sites than they are to the QEW. As a result these trips route along other provincial highways or regional roads to access the candidate site(s) in the most efficient manner. In certain instances these movements may intercept the preferred access routes at various points, while in other instances the routing adopted is unique.

To assess the potential for and significance of these special routings a special analysis was made of these in relation to the West Lincoln sites. This necessitated a finer breakdown in waste source quantities by local areas as opposed to the aggregated quantities used from an assumed waste source centroid within the 33 municipal areas used in the transport modelling. It was determined that approximately 19 trucks per day would use routes other

than Niagara Regional Road 24 between the QEW and the Highway 20 intersection to reach the site. However, of these 19 trucks, 18 would use the Highway 20 road link from the intersection of Highway 20/RR 24. These vehicles would likely arrive at this intersection from the east on Highway 20 (11 vehicles) and the balance from the south on RR 24 (7 vehicles). The remainder (1 vehicle) would use appropriate routes coming from the southwest of the West Lincoln area.

This situation, as detailed above, could occur with respect to all candidate sites but to a greater or lesser extent. Within the Milton sites geographic area, nearby source generators may use other provincial or regional road routings due to their proximity to other roads and the sites. Similarly, with respect to the Niagara Falls sites, shipments arriving from the Welland and Port Colborne areas may use routes other than the QEW.

For site selection purposes the accident rates and spill rates developed for site comparison remain valid in that all unique routings are recognized. Even the use of unique routings, approaching a candidate site, does not pose an unexpected outcome since this will likely also occur within the vicinity of individual waste source generators at all municipal areas of generation. Also, truck routings to a selected preferred site can be potentially controlled by agreement between the waste haulers and/or waste generators and the OWMC. In conclusion, the modelling approach used and the evaluations conducted of the primary access route(s) has been consistently applied and is therefore valid for the comparison and the selection of a preferred site(s).

6.3.4 Vehicle movements

The modelling approach used and the analysis conducted during Phase 4A concentrated on the vehicle movements for transporting

special wastes, the process reagents and additives to treat the waste and the resulting processed waste residuals. These trips will make up the majority of the vehicle movements to each of the candidate sites. However, there are known vehicle movements that have not been incorporated into Phase 4A transportation site selection work.

The transportation of granular material for the drainage system of the landfill cells was estimated at 250 trucks/year over the construction period of each set of cells. The principle reason for not including these movements in the modelling process is that the transport costs are included with the capital cost of preparing the landfill. Furthermore, the source points were not identified for developing the vehicle routings due largely to the abundant supply in close proximity to each candidate site and the relatively small quantity that would make a minor contribution to the accident frequency and would have no impact on site selection.

Similarly, there may be other small quantity movements that have not been incorporated in Phase 4A work, however as the treatment process becomes more defined and/or more detailed information becomes available, it is recommended that a more detailed analysis of these quantities movements be undertaken.

CHAPTER 3

REFINEMENT OF SITE BOUNDARIES

1. INTRODUCTION

This chapter describes the transportation input regarding the refinement of boundaries at certain candidate sites. This was necessary because certain of the candidate sites were larger than required for planned site development. The activity was applied only to candidate sites PI-1N, LF-3C and LF-1E, as only these sites required boundary refinement. Concurrent with this activity, work was in process on the other activities involved in the refinement of siting options, including:

- ° Comparison of access road options,
- ° Comparison of rail access options, and
- ° Basic acceptability analysis.

Thus, this was an iterative process in that conclusions arising from one of these activities had implications in relation to others.

2. FRAMEWORK AND ASSUMPTIONS

There were three candidate siting options where the boundary refinement analysis was carried out: PI-1N, LF-3C, LF-1E.

Sites LF-3C and LF-1E were considered for integrated facilities, and site PI-1N was considered for either the physical chemical treatment plant and incinerator facilities, or a separate incinerator alone. Site LF-1E could also accommodate a separate landfill or a landfill with the physical chemical plant if used in combination with site PI-27E, which would accommodate the remaining site component(s).

A constraint mapping methodology was applied to this stage of the preliminary Phase 4A work. Risk, impact and cost constraints were considered, and portions of the sites were eliminated if they were "clearly less suitable" than the retained portions.

The only transportation input to this analysis concerned the location of the incinerator stack in relation to the restrictions imposed by any nearby airport. This constraint was only applicable at site PI-1N.

3. IDENTIFICATION OF TRANSPORTATION INPUTS

Sites PI-1N and LF-4N in the Milton area have been identified as having a possible navigational conflict with the Burlington Airpark should an incinerator stack (60 to 100 metres in height) be placed on either site. In the case of site LF-4N this restriction contributed to the Phase 3B conclusion that no incinerator could be placed on this site.

However, for candidate site PI-1N it was noted that the east portion of the site was free from these navigational constraints due to spatial separation greater than 4,000 metres from the Burlington Airpark facility.

3.1 NAVIGATIONAL CONSTRAINTS AND INCINERATOR STACK HEIGHT

The obstacle control height limitation of 45 m within 4000 m of the theoretical centroid of an airport's landing surface is an absolute control in relation to Transport Canada controlled facilities. Other airport facilities, such as the Burlington Airpark, do not have this restrictive protection; however, infringement within this obstacle control surface could adversely affect airport licensing and thus present use as documented in the report, M.M. Dillon Ltd., Site Selection Process, Phase 3B: Selection of Candidate Sites - Transportation, October 1984.

Concern has been expressed by Transport Canada officials with respect to the obstacle limitation surface at the Burlington Airport, as navigation is already constrained due to the Niagara escarpment which is located a short distance to the west of this airfield. This physical restraint limits aircraft operation to an easterly circuit over a portion of candidate site PI-1N. Consequently, an incinerator stack height of greater than 45 m within 4000 m of the airport could affect the licensing and operation at the Burlington Airpark.

During the Phase 3B Site Selection process (Dillon 1984), an incinerator stack height of 100 m maximum was assumed. As a result of more detailed engineering analysis as reported in, Monenco Limited, Status Report - Facility Design, April 1985, it was concluded that the incinerator stack would have a nominal

height of 60 m. As the range in potential stack heights exceeds the 45 m limitation, it was concluded that the location of the incinerator stack should be beyond the 4000 m control surface to avoid conflict with operation at the Burlington Airpark.

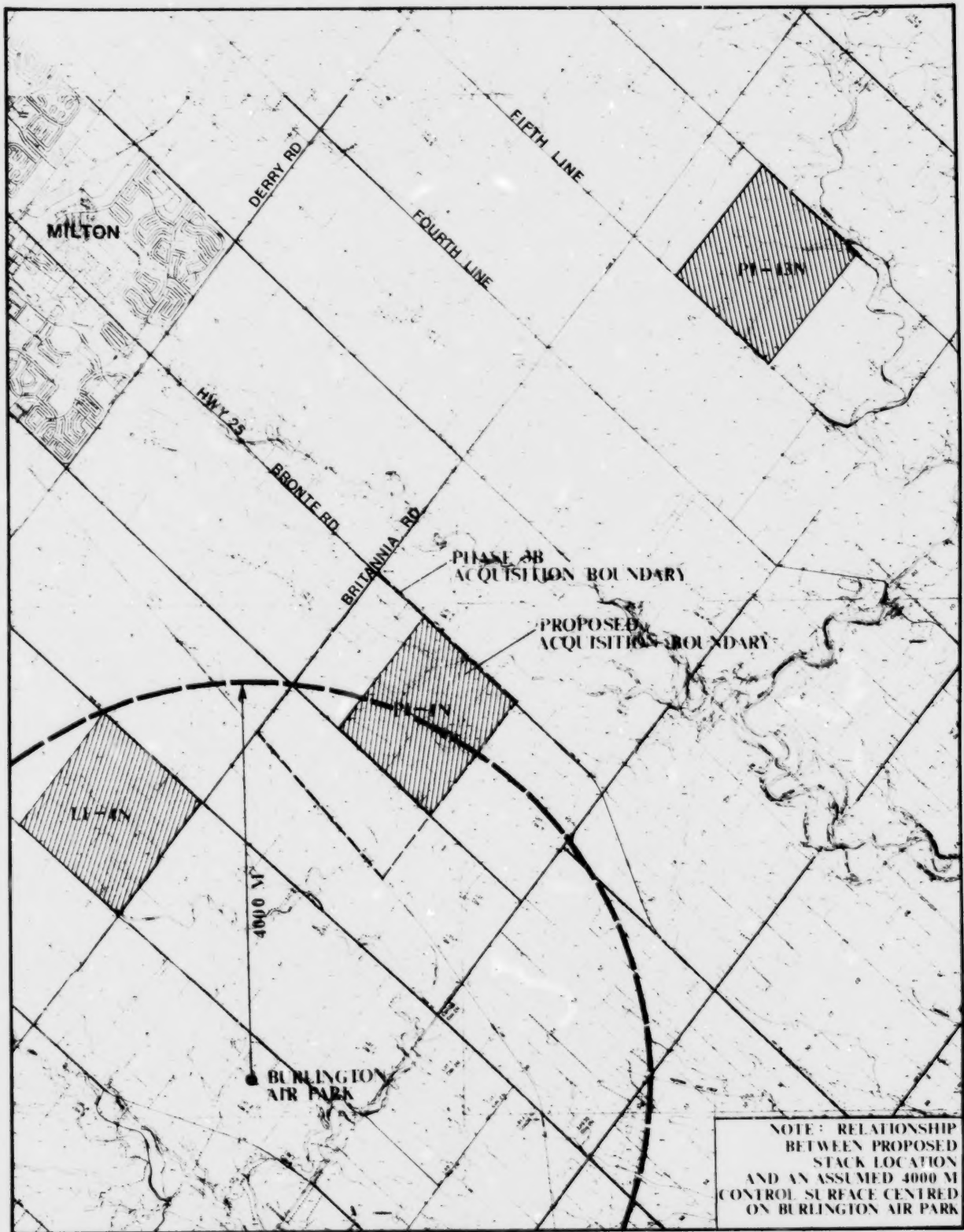
4. DATA COLLECTION AND ANALYSIS

In assessing the conflicts at site PI-1N, it was necessary to meet with Transport Canada officials to confirm the extent of the constraints in the vicinity of the site, and secure their comments regarding an incinerator stack on site PI-1N. Also, a meeting was held with the Airport Operator at the Burlington Airpark to receive his comments on the airport's operations, proposed facility expansion and potential conflict with the incinerator stack.

As a result of these discussions, the extent of the 45 m height restriction was plotted on the constraint mapping for site PI-1N. Figure 3.1 illustrates how the Burlington Airpark constraint cuts through the site, restricting development to the eastern portion only. There is still sufficient area remaining to locate the plant and incinerator stack on site PI-1N with this restriction from the Airpark.

4.1 INCINERATOR STACK LOCATION

A 1:10,000 scale plan, similar in content to the information presented in Figure 3.1 was prepared and submitted to Transport Canada officials at a meeting held in their offices on 28 June 1985. This plan identified the following information:



NOTE: RELATIONSHIP
BETWEEN PROPOSED
STACK LOCATION
AND AN ASSUMED 4000 M
CONTROL SURFACE CENTRED
ON BURLINGTON AIR PARK

OWMPC Ontario
Waste Management
Corporation
Consultant
DILLON

REFINEMENT OF SITE
BOUNDARIES WITHIN CANDIDATE SITE PI-1N
PHASE 4A
TRANSPORTATION
FIGURE 3.1

- ° location of candidate site PI-1N in relation to the Burlington Airpark facility;
- ° location of the 4,000 m control surface limit with respect to an assumed reference point located on the Burlington Airport primary runway;
- ° location of the proposed acquisition boundaries for site PI-1N; and
- ° location of the facility plant and incinerator stack within the acquisition boundaries.

Based upon the information submitted, there was agreement that the location of the incinerator stack would not conflict with Burlington Airpark operations and the air navigation pattern required at this airfield. Consequently, the PI-1N site boundary refinement and facility plant location as shown in Figure 3.1 was adopted for ongoing analysis of this site.

4.2 INCINERATOR STACK OBSTRUCTION LIGHTING

During prior discussions and meetings with Transport Canada staff, it was ascertained that any OWMC incinerator stack would require obstruction lighting. The general lighting requirements for a 100 m stack were identified by a communication dated 29 November 1985 from Mr. S.E. Livingston, Regional Manager, Planning and Programming Branch, to M.M. Dillon Limited. The requirements, as extracted from this communication, are as follows:

The minimum requirement is two red dual unit flashing hazard beacons located 6 feet below the top of the stack, and two dual unit red steady burning obstruction lights at the halfway point. For large diameter stacks, each level must be fitted with enough lights so that at least one is visible from any angle around the stack.

For details on candlepower, wattage, angle settings etc. reference must be made to TP382E.

The information on obstruction lighting requirements was provided to the OWMC for purposes of facility engineering design and cost analysis.

5. CONCLUSIONS AND RECOMMENDATIONS

The refinement of boundaries for locating the treatment facilities was a preliminary activity carried out prior to the comparative analysis of siting options. Through this analysis it was possible to avoid potential conflicts with on and off-site features which could endanger human health and the environment.

The results of the boundary refinements associated with candidate site PI-1N, as well as those identified in other consultant reports and the report, M.M. Dillon Ltd., Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection, 1985, concerning LF-3C and LF-1E, were applied to the site selection activities reported in Chapters 4, 5 and 6 of this report.

Figure 4.1 shows the refined site boundary for site LF-3C. The boundary refinement for site LF-1E is shown in Figure 4.3. The PI-1N refined site boundary is shown in Figure 4.5.

CHAPTER 4

ACCESS ROAD OPTIONS

1. INTRODUCTION

During the access road option selection portion of Phase 4A, a number of local and regional access road options between the sites and a 400-series highway (including QEW) facilities were identified and compared.

The selection of access roads was a two-stage process which involved a preliminary investigation of a number of alternative routes largely using factors applied during Phase 3B. The alternative routes which remained following the preliminary evaluation were evaluated using Phase 4A factors. The methodologies and results of both stages are described in this chapter. The data matrices containing the information on the preliminary alternative route options are contained in Appendix A of the Transportation Technical Appendices.

Site boundary refinements at candidate sites LF-1E, LF-3C, and PI-1N, as described in Chapter 3, resulted in the addition, and deletion of some access options, identified following the preliminary Phase 4A access road option investigation, in order to provide access to the treatment facilities within the refined boundaries. The Phase 4A access road option evaluation considers only the access routes remaining after the site boundary refinements had been carried out.

This chapter details the process of applying the transportation factors to both stages of the access road option comparison. The framework and assumptions are discussed, the factors and indicators are developed and aggregated, and the data collection and analysis is outlined. The conclusions and recommendations made regarding these road options is from the transportation perspective alone. The identification of the preferred road access option resulted from the synthesis of all the inputs by the site selection team, and the preferred route was carried into the site option comparisons.

1.1 FACTOR APPLICATION BY ANALYSIS STAGE

As the selection of local and regional access route options and inter-site transfer routes between non-integrated sites was a two-stage process, it was necessary to develop a series of factors/indicators that would apply to the risk, impact and cost goals. Certain of these were applied at each stage of analysis.

Table 4.1 provides a summary of the factors/indicators developed and applied during each of the two stages. The details of their development and application is presented in this chapter. Reference is also required to Appendices A, D and L of the Transportation Technical Appendices as will be noted in the discussion.

2. PRELIMINARY PHASE 4A ACCESS ROUTE ANALYSIS

2.1 INTRODUCTION

A preliminary access route analysis was carried out prior to the Phase 4A access route analysis described later in this chapter. This analysis largely utilized factors applied during Phase 3B of

TABLE 4.1
OWMC PHASE 4A - TRANSPORTATION
TRANSPORTATION FACTORS AND INDICATORS APPLIED IN
EACH STAGE OF ACCESS ROAD OPTION COMPARISON

<u>Factor/Indicator</u>	<u>Stage of Application</u>		<u>Information supplied to other Consultants</u>
	<u>Preliminary Phase 4A Access Road Option Comparison</u>	<u>Phase 4A Analysis Access Road Option Comparison</u>	
<u>1. Transport Safety</u>			
a) Proximity to arterial roads:	X		
b) Number of level rail crossings on local roads:	X		
c) Accidents/million vehicles:	X	X	
d) Distance to freeway system:	X		
e) Total number of level rail crossings:	X		
f) Number of intersections where turn is required:	X	X	
g) Range of existing volume to capacity (v/c) ratio along route:		X	
<u>2. Road Improvement Costs</u>			
a) Preliminary estimate of construction cost for road improvement:		X	
b) Estimated amount of additional land required for road right-of-way:		X	
<u>3. Noise Impacts</u>			
a) Estimated width of corridor where noise level increases are expected:			X

the site selection process. Factors and information supplied by all site selection consultants were synthesized in this preliminary access road selection process to eliminate less suitable routes. The method of synthesis is described in the report, M.M. Dillon Ltd., 1985, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection.

The access road options considered during this stage of the analysis are listed in Table 4.2 for each siting option.

Figures 4.1 through 4.12 illustrate the total array of access route options for both stages of analysis. Access route options eliminated during the preliminary analysis are identified by the legend applied.

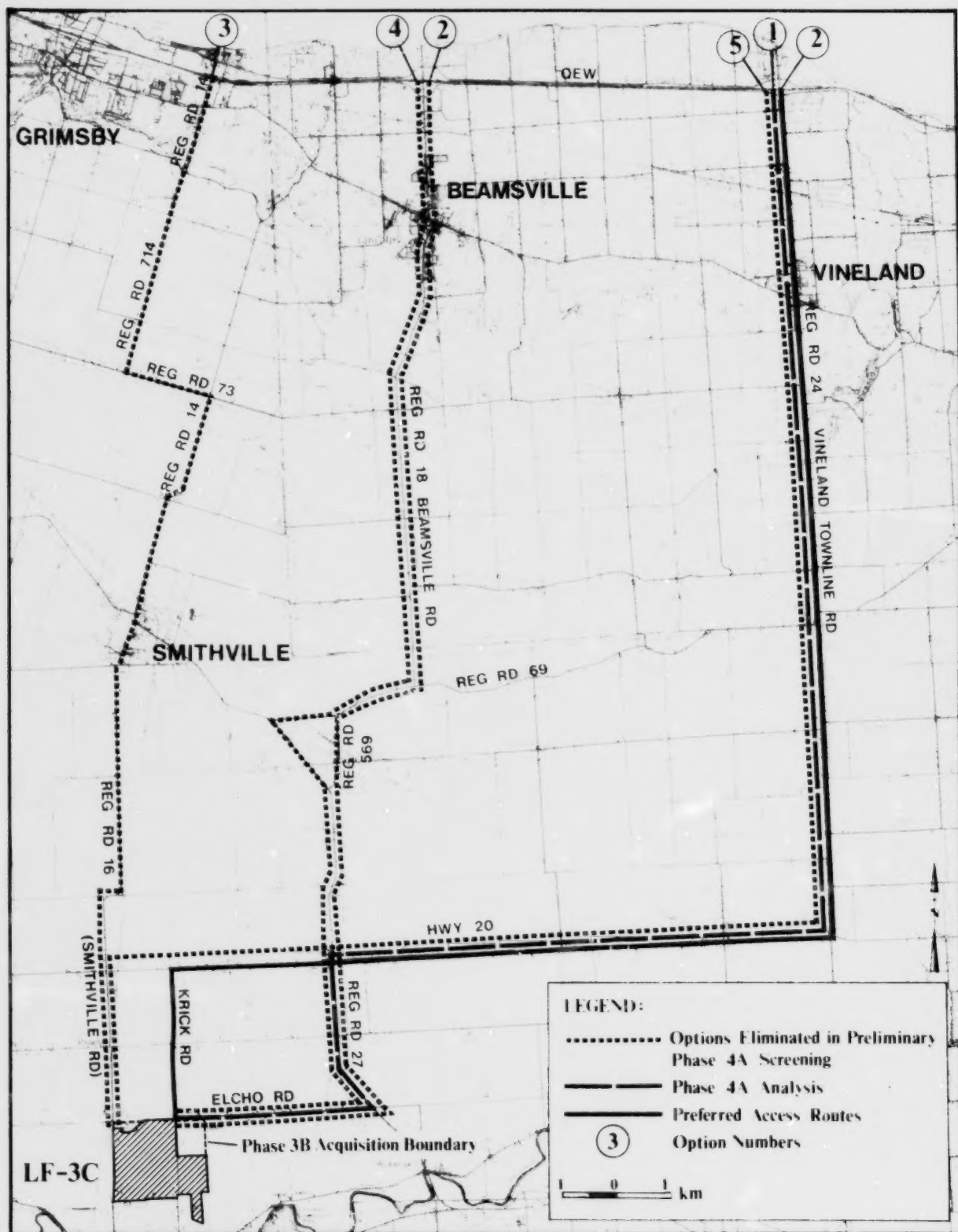
The following sections describe the transportation inputs, methodology, analysis and results related to the preliminary access route examination.

2.2 FACTORS AND METHODOLOGY

The transportation factor applied during this analysis was Transport Safety and the indicators corresponded closely to those used during Phase 3B:

- ° proximity to arterial roads
- ° number of level railway crossings on local roads and on total route
- ° composite accident rate (accidents per million vehicles)
- ° proximity to 400 series highway
- ° number of intersection turns

With the exception of the composite accident rate, the information collected in the previous phase was applied directly

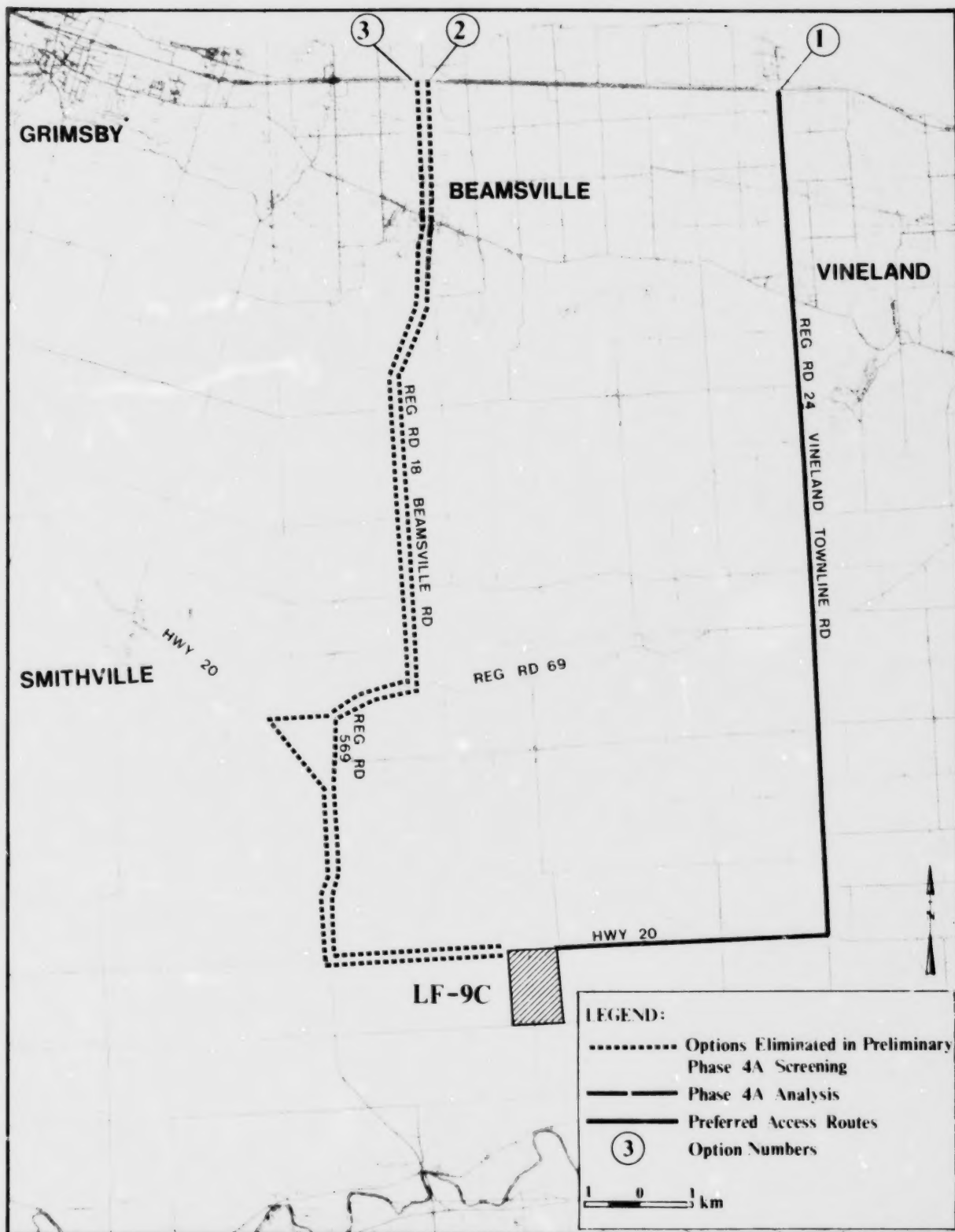


OWMC SITE SELECTION
- TRANSPORTATION

DILLON

LF-3C
PHASE 4A ACCESS ROADS

FIGURE 4.1

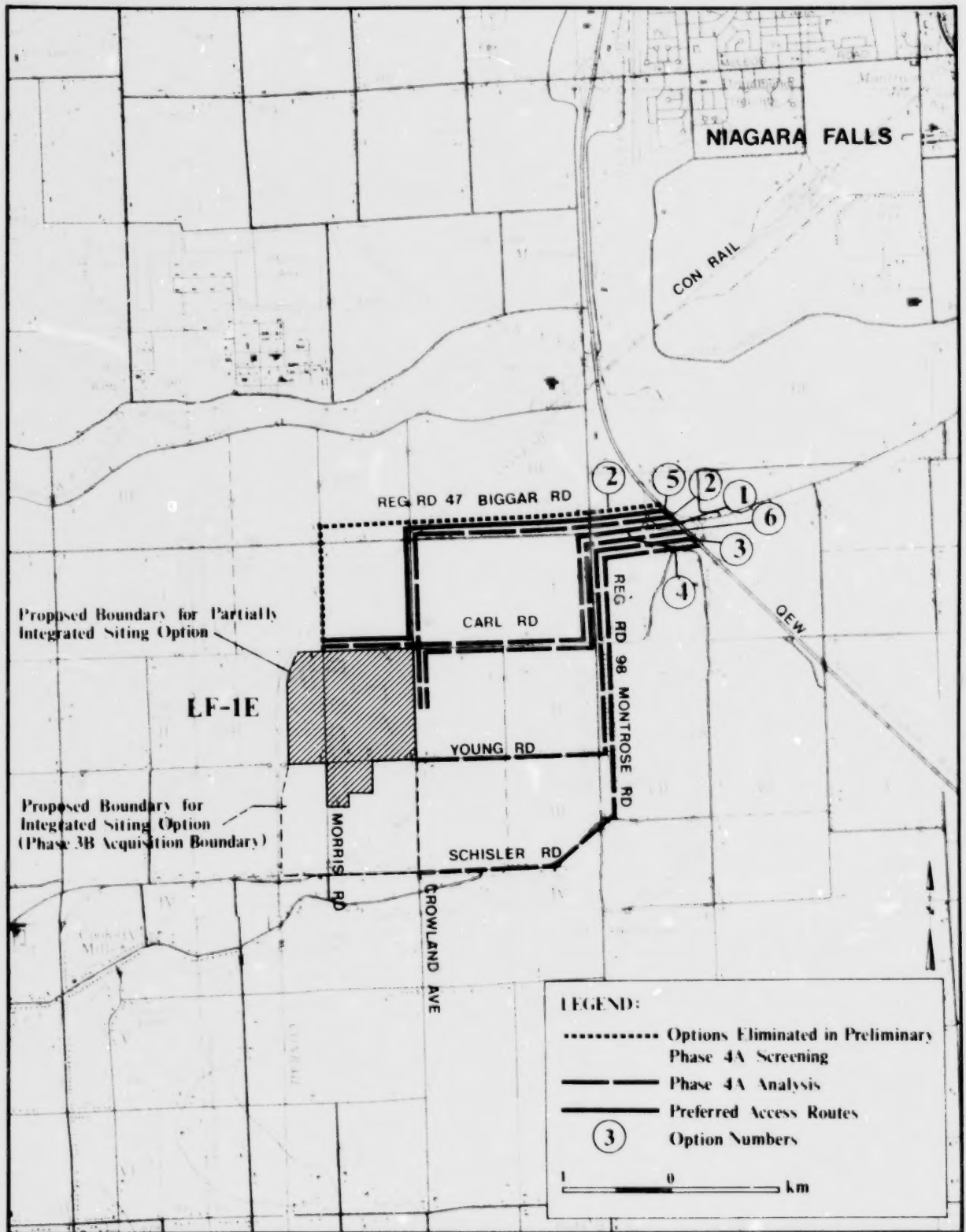


OWMC SITE SELECTION
- TRANSPORTATION

LF-9C
PHASE 4A ACCESS ROADS

DILLON

FIGURE 4.2

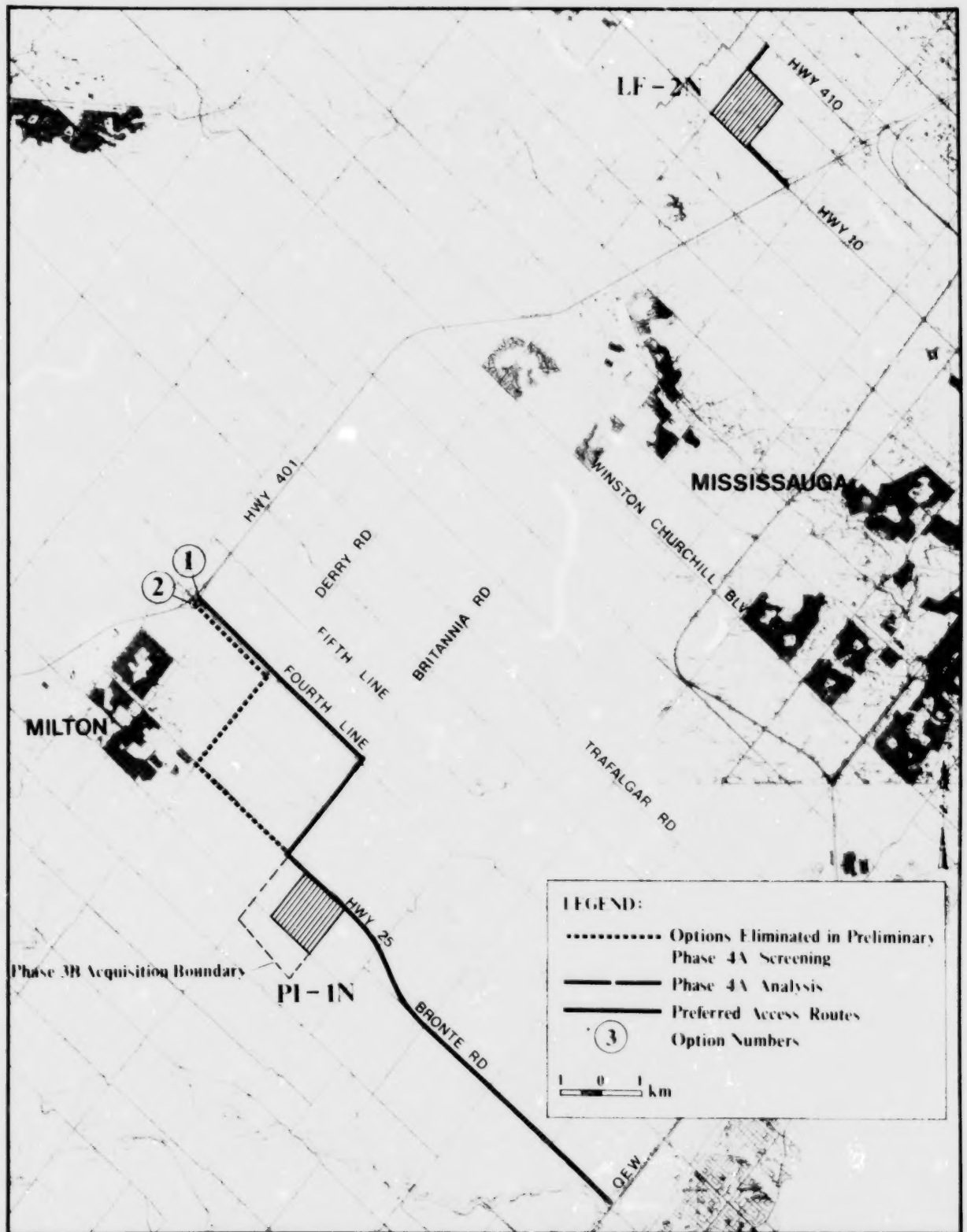


OWMC SITE SELECTION
-TRANSPORTATION

LF-1E
PHASE 4A ACCESS ROADS

DILLON

FIGURE 4.3

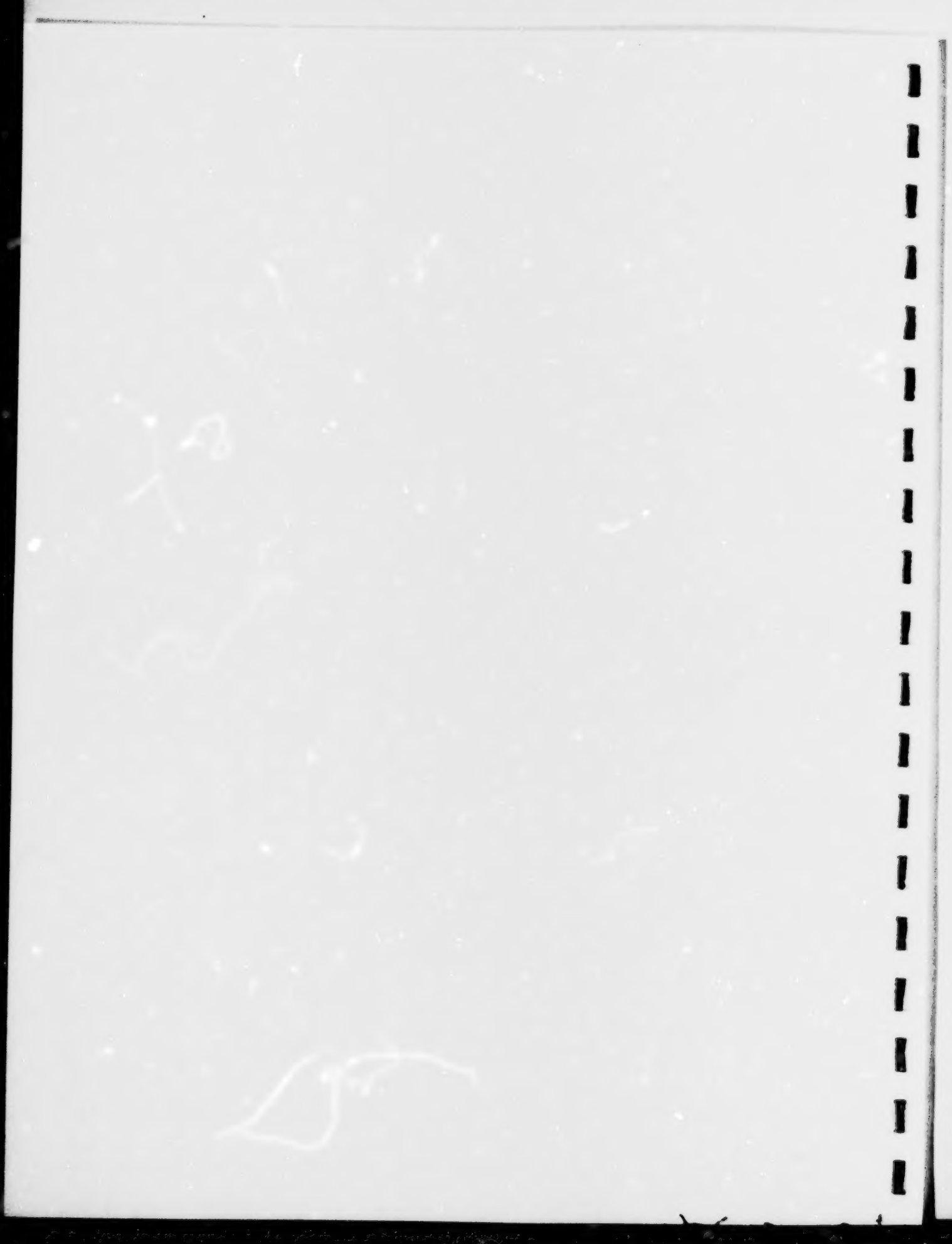


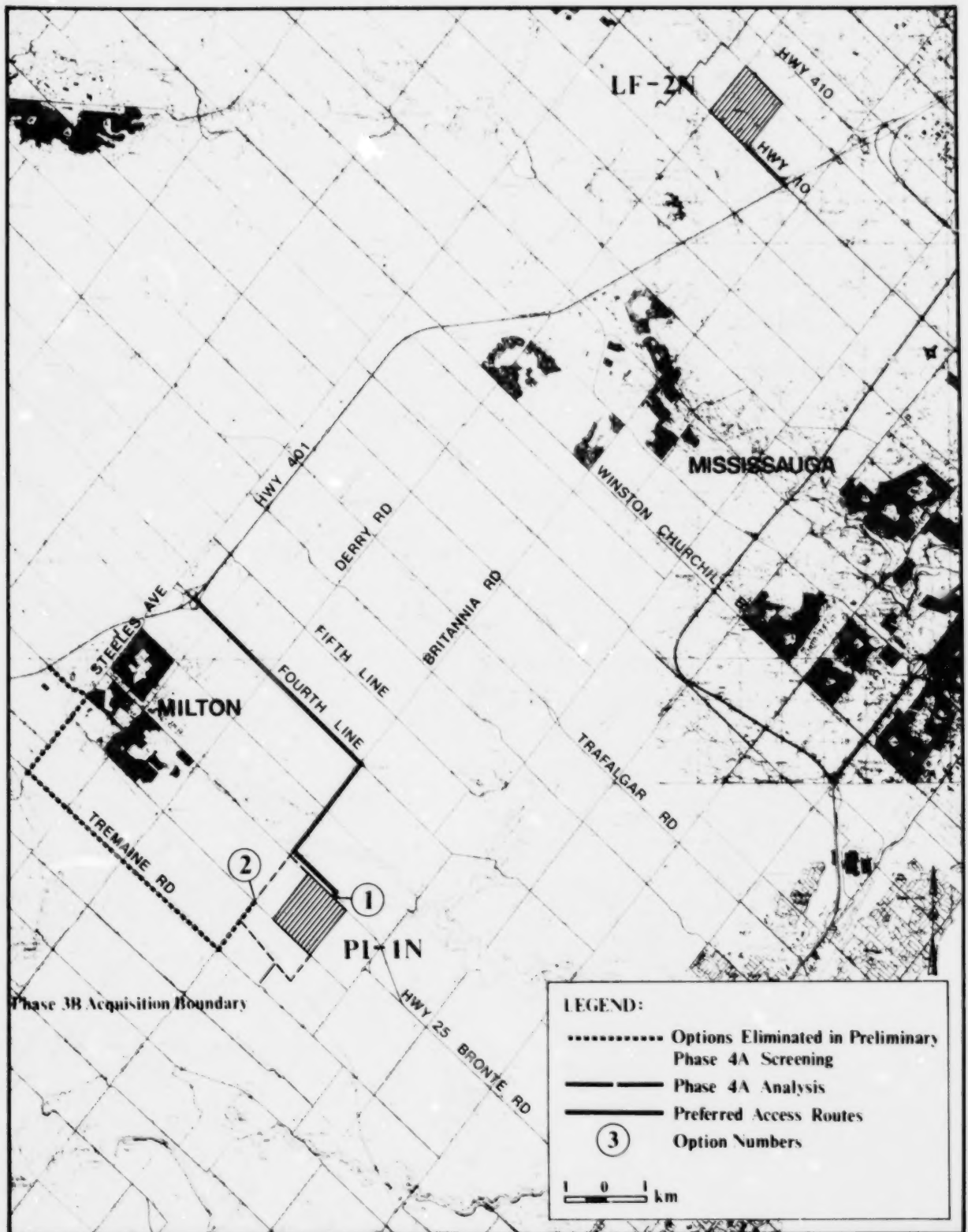
OWMC SITE SELECTION
- TRANSPORTATION

LF-2N/PI-1N
TO PI-1N
PHASE 4A ACCESS ROADS

DILLON

FIGURE 4.4



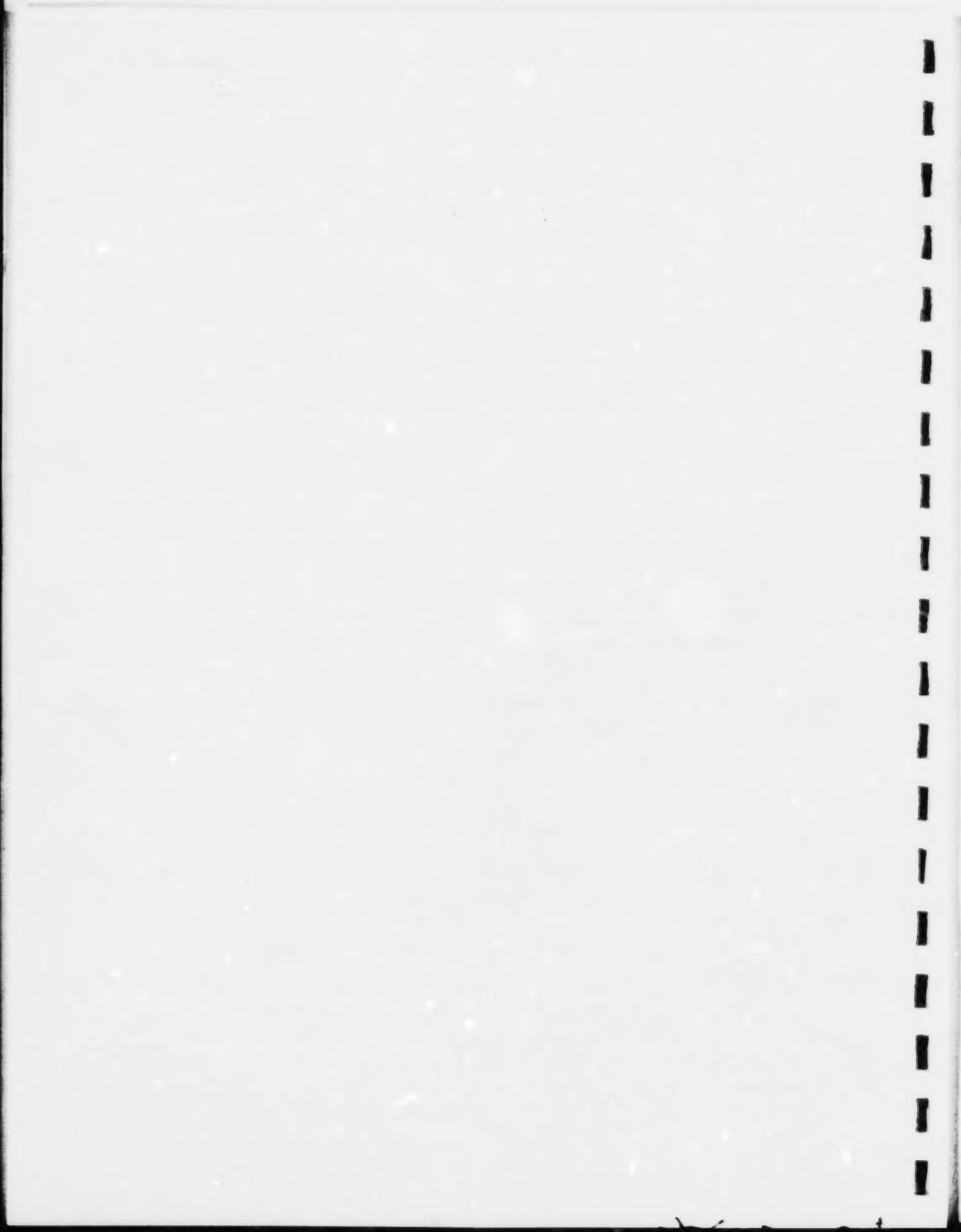


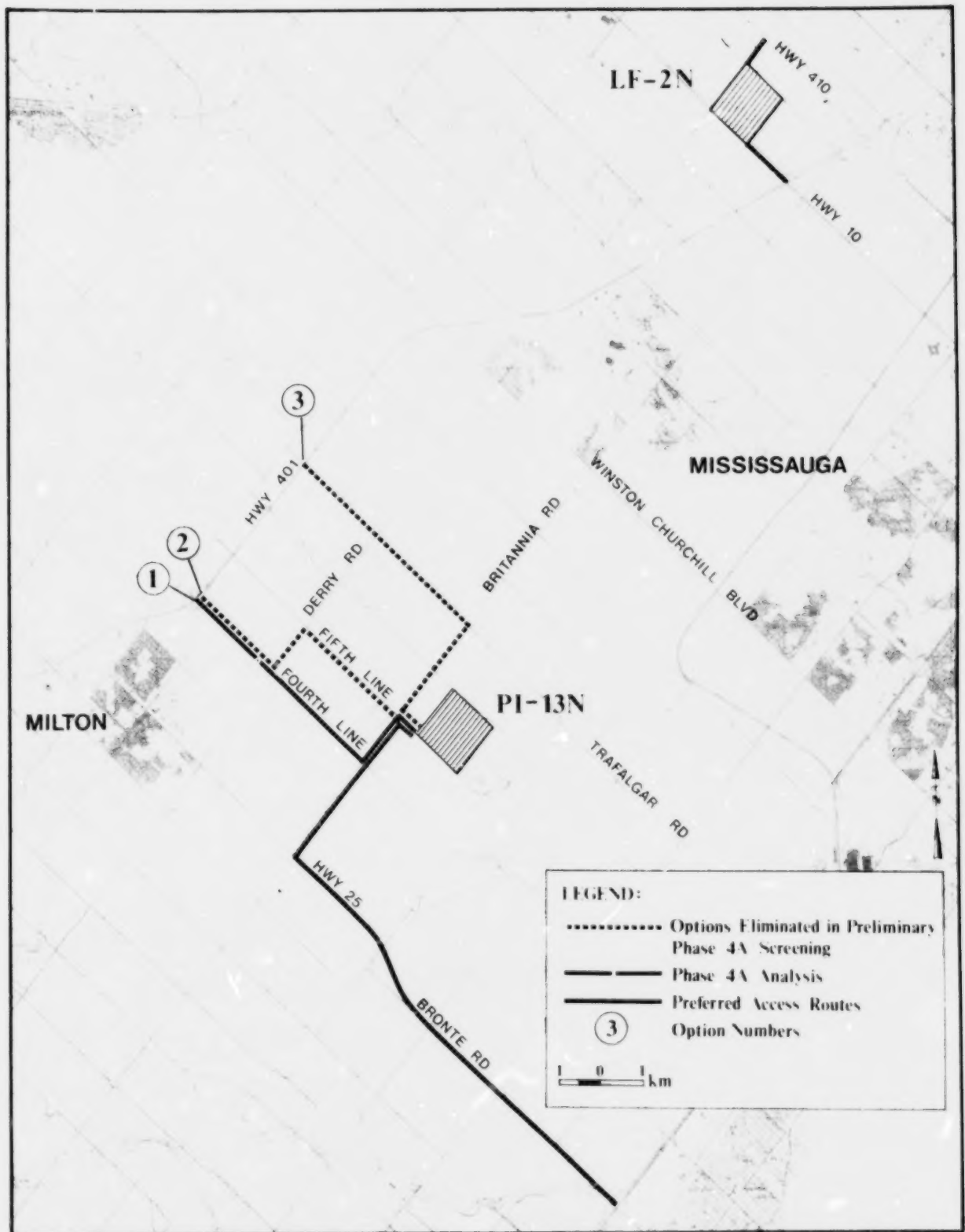
OWMC SITE SELECTION
-TRANSPORTATION

LF-2N/PI-1N
PI-1N TO LF-2N
PHASE 4A ACCESS ROADS

DILLON

FIGURE 4.5





OWMC SITE SELECTION
-TRANSPORTATION

LF-2N/PI-13N
TO PI-13N
PHASE 4A ACCESS ROADS

DILLON

FIGURE 4.6



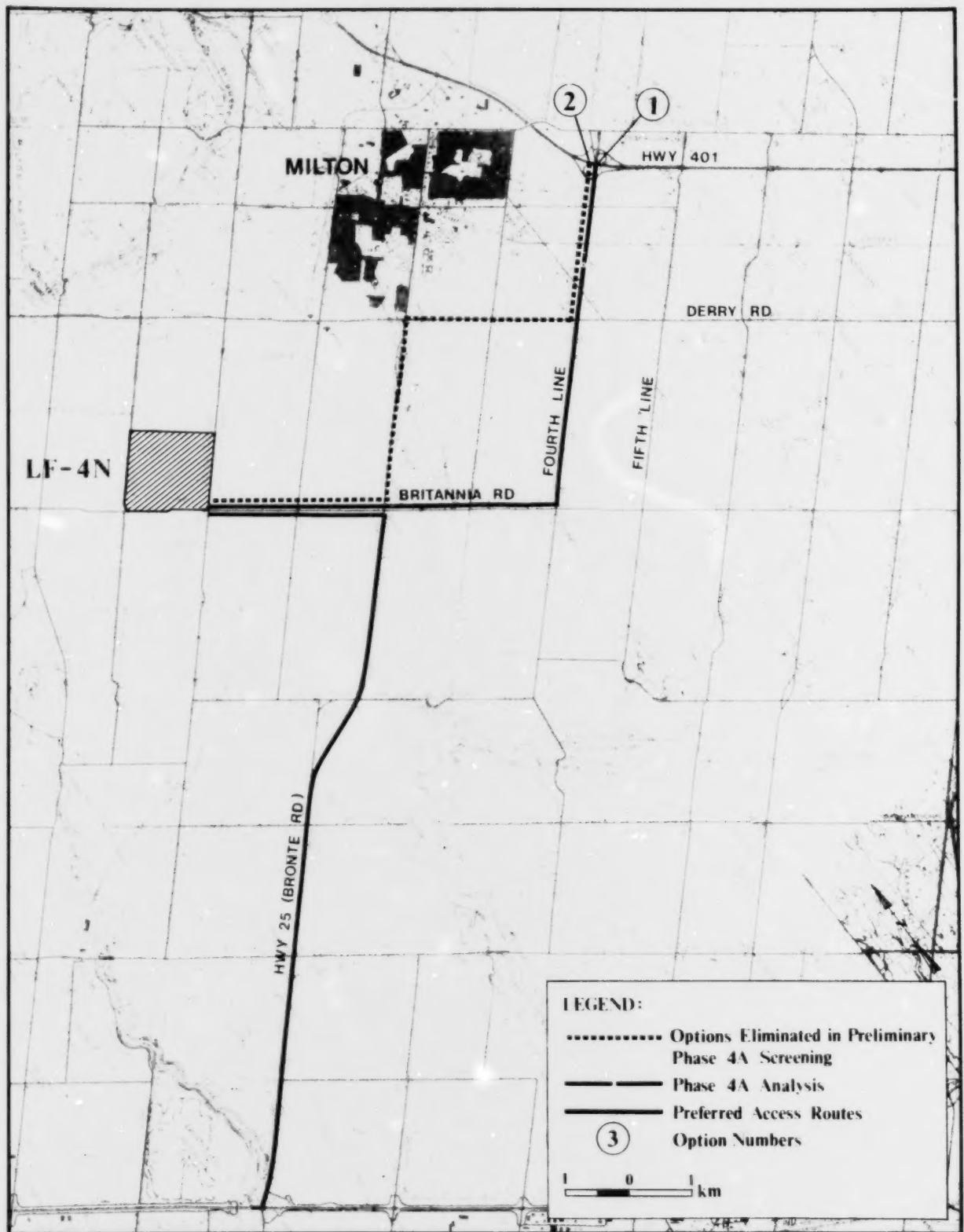
OWMC SITE SELECTION
- TRANSPORTATION

LF-2N/ PI-13N
PI-13N TO LF-2N
PHASE 4A ACCESS ROADS

DILLON

FIGURE 4.7





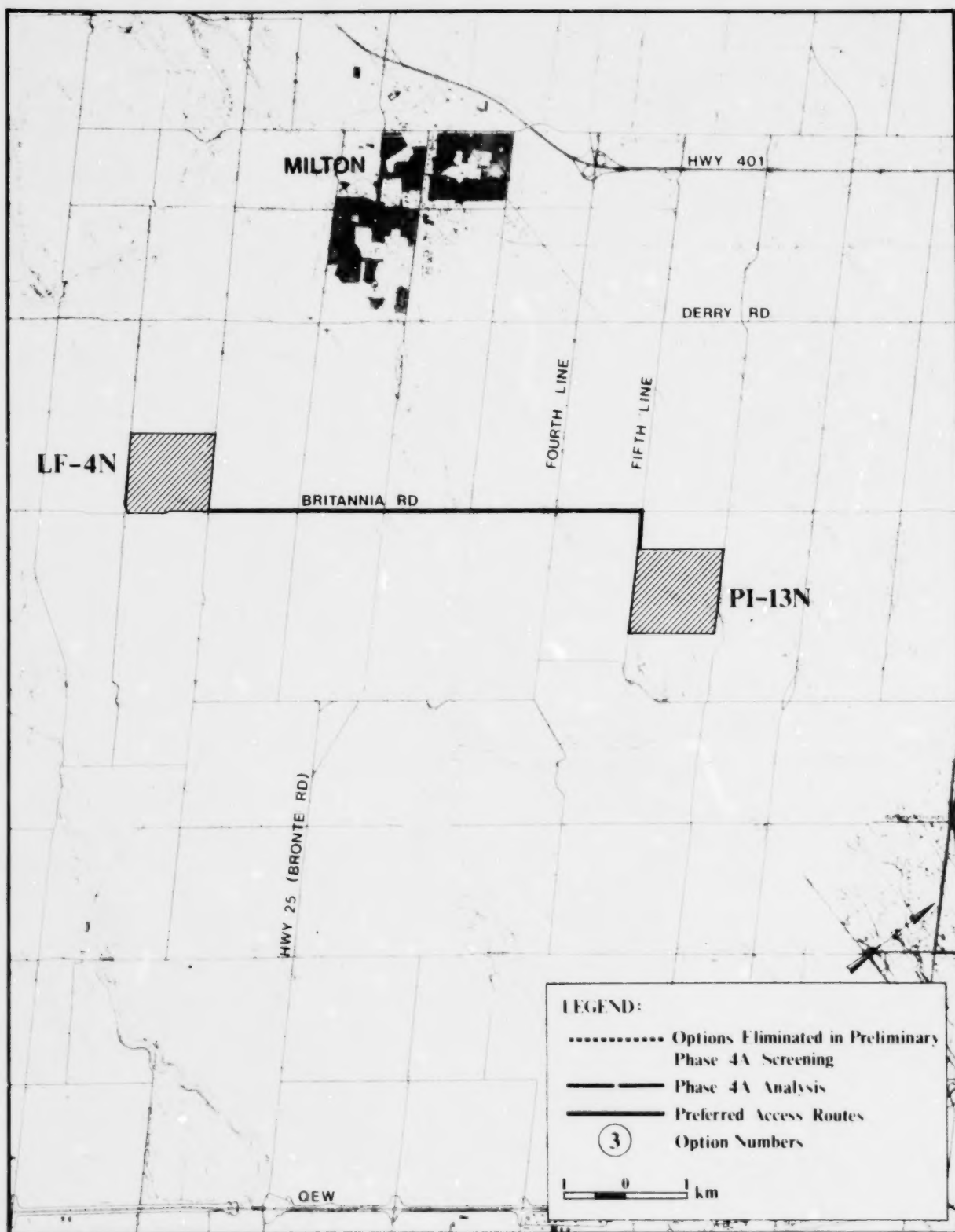
OWMC SITE SELECTION
- TRANSPORTATION

LF-4N / PI-1N
TO LF-4N
PHASE 4A ACCESS ROADS

DILLON

FIGURE 4.8



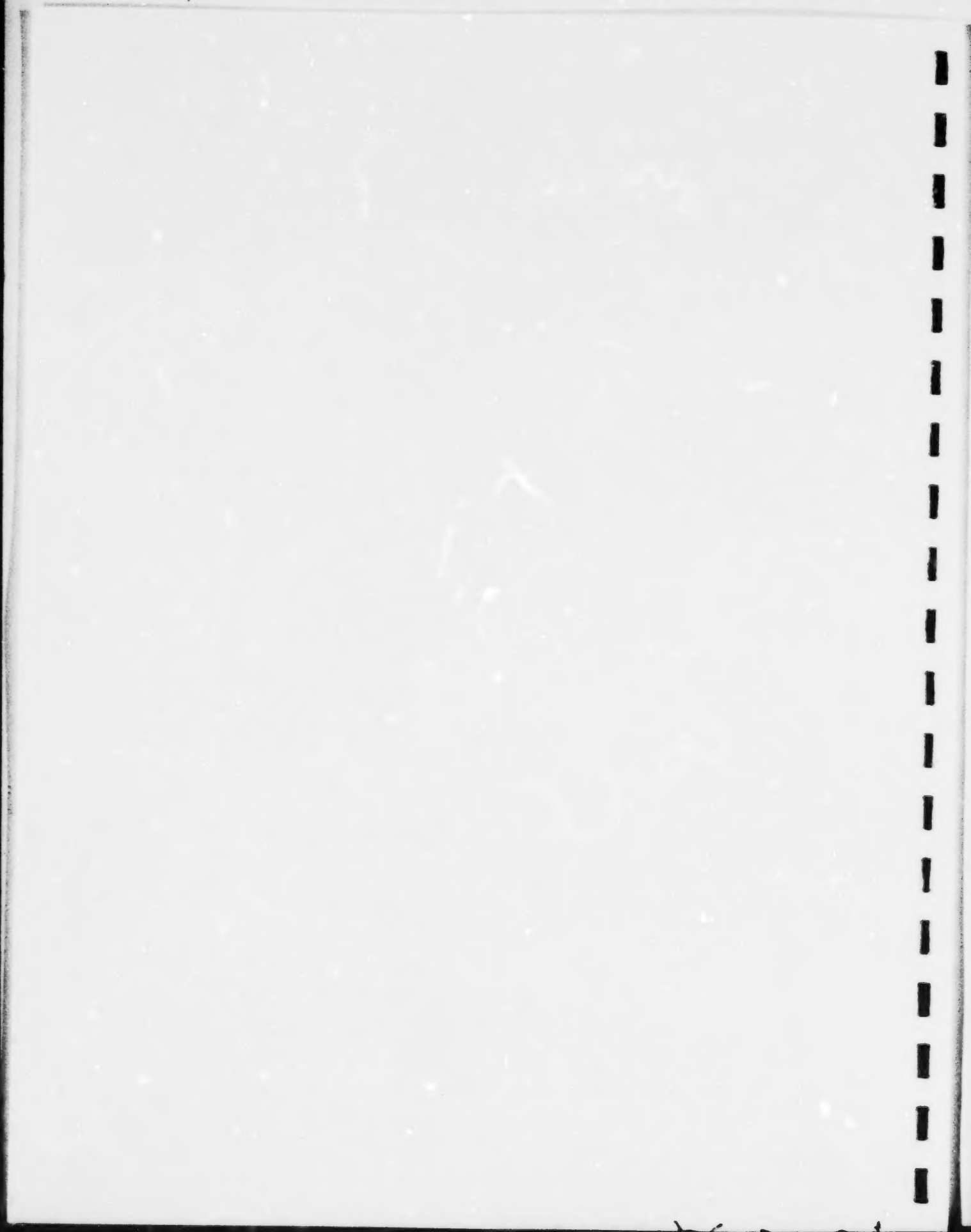


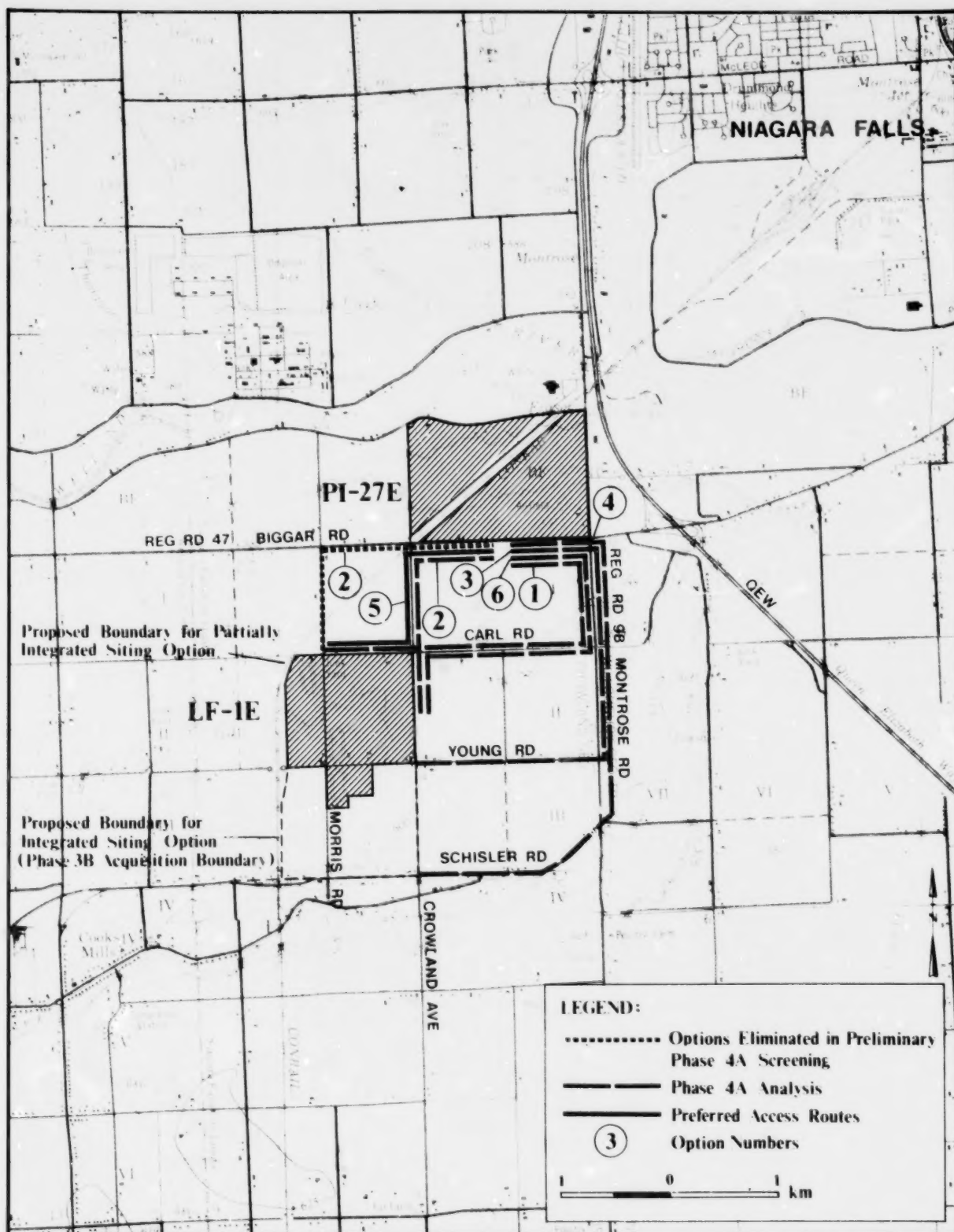
OWMC SITE SELECTION
- TRANSPORTATION

LF-4N/ PI-13N
PI-13N TO LF-4N
PHASE 4A ACCESS ROADS

DILLON

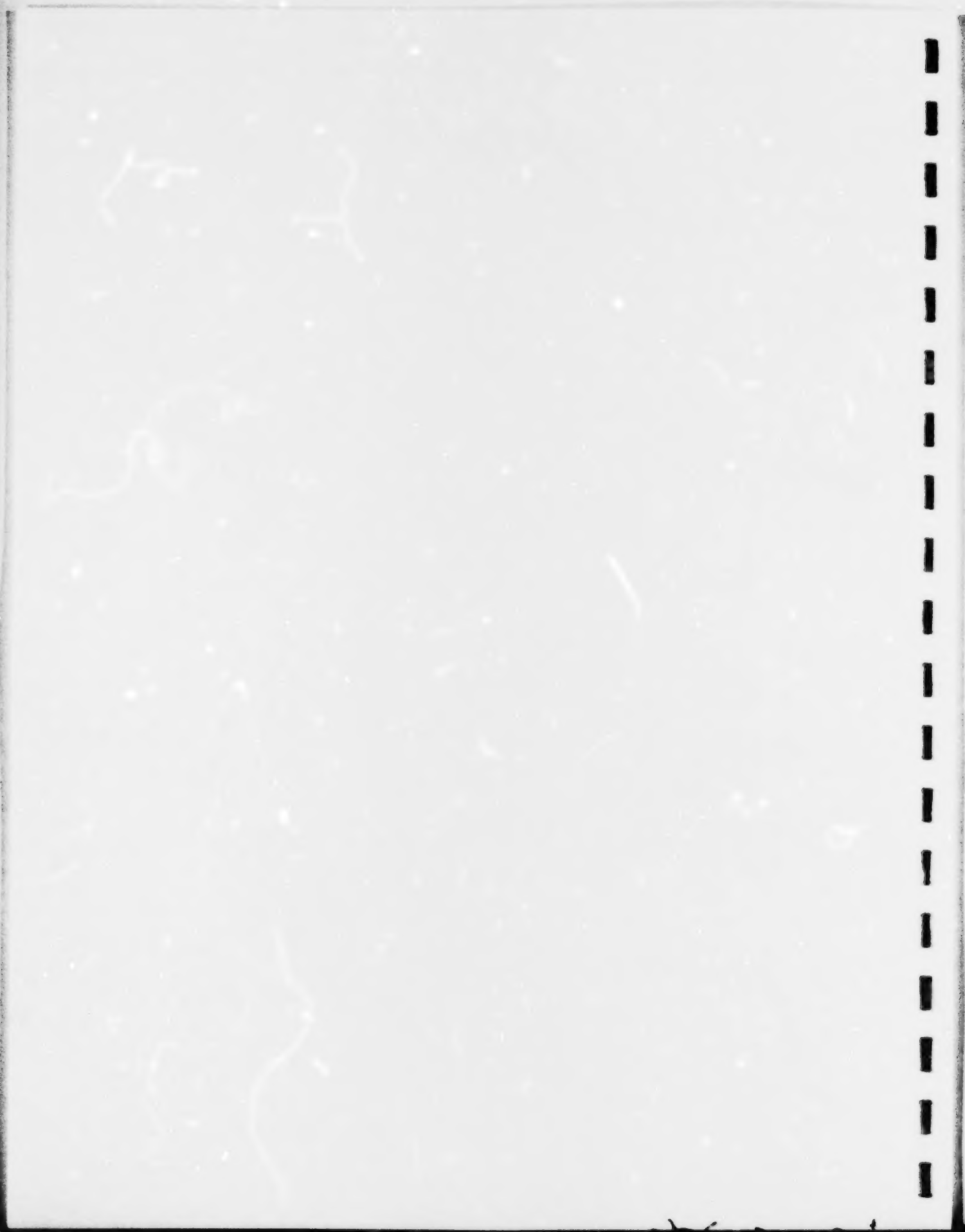
FIGURE 4.10

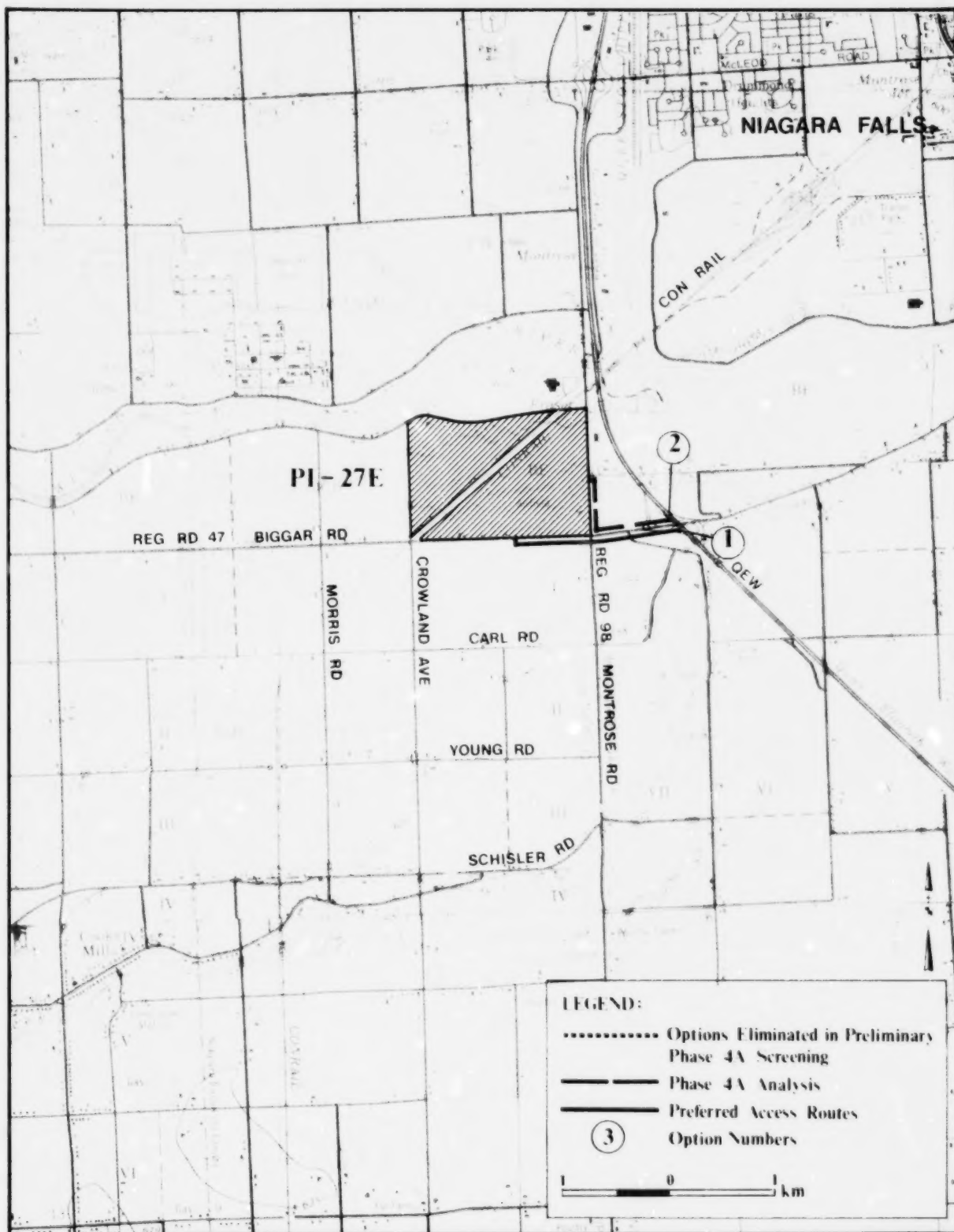




LF-1E/ PI-27E
PI-27E TO LF-1E
PHASE 4A ACCESS ROADS

FIGURE 4.11





OWMC SITE SELECTION
- TRANSPORTATION

LF-1E/PI-27E
TO PI-27E
PHASE 4A ACCESS ROADS

DILLON

FIGURE 4.12



TABLE 4.2
OWMC PHASE 4A - TRANSPORTATION
ACCESS ROUTE OPTIONS CONSIDERED IN PRELIMINARY PHASE 4A

LF-3C

1. from QEW - south on Vineland Townline Road (Niagara Regional Road 24); west on Highway 20; south on Niagara Regional Road 27; west on Elcho Road to LF-3C
- *2. from QEW - south on Niagara Regional Road 18 (Beamsville Road); west on Niagara Regional Road 69 (Twenty Mile Road); south on Niagara Regional Road 569; south on Highway 20; south on Niagara Regional Road 27; west on Elcho Road to LF-3C
- *3. from QEW - south on Niagara Regional Road 14; south on Niagara Regional Road 714; east on Niagara Regional Road 73; south on Niagara Regional Road 14; south on Niagara Regional Road 16 to LF-3C
- *4. from QEW - south on Niagara Regional Road 18 (Beamsville Road); west on Niagara Regional Road 69; south on Highway 20; south on Niagara Regional Road 27; west on Elcho Road to LF-3C
- *5. from QEW - south on Vineland Townline Road (Niagara Regional Road 24); west on Highway 20; west on Niagara Regional Road 65 from Bismarck; south on Smithville Road (Niagara Regional Road 16) to LF-3C
6. from QEW - south on Vineland Townline Road (Niagara Regional Road 24); west on Highway 20; west on Niagara Regional Road 65 from Bismarck; south on Krick Road to LF-3C

LF-9C

1. from QEW - south on Vineland Townline Road (Niagara Regional Road 24); west on Highway 20 to LF-9C
- *2. from QEW - south on Niagara Regional Road 18; west on Niagara Regional Road 69; south on Niagara Regional Road 569; south on Highway 20; east on Highway 20 from Bismarck to LF-9C
- *3. from QEW - south on Niagara Regional Road 18; west on Niagara Regional Road 69; south on Highway 20; east on Highway 20 to LF-9C

TABLE 4.2
OWMC PHASE 4A - TRANSPORTATION
ACCESS ROUTE OPTIONS CONSIDERED IN PRELIMINARY PHASE 4A
(continued)

LF-1E

1. from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road); south on Niagara Regional Road 98 (Montrose Road); west on Carl Road to LF-1E
- *2. from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road); south on Morris Road to LF-1E
3. from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road); south on Crowland Ave. to LF-1E
4. from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road); south on Montrose Road (Niagara Regional Road 98); west on Young Road to LF-1E
5. from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road); south on Montrose Road (Niagara Regional Road 98); west on Schisler Road (Niagara Regional Road 27) to LF-1E

LF-2N/PI-1N
to PI-1N

1. from 401 - south on Fourth Line (partly Halton Regional Road 4); west on Britannia Road (Halton Regional Road 6) to PI-1N
- *2. from 401 - south on Fourth Line (Halton Regional Road 4); west on Derry Road (Halton Regional Road 25); south on Highway 25 to PI-1N

PI-1N to LF-2N

1. east on Britannia Road (Halton Regional Road 6); north on Fourth Line (partly Halton Regional Road 4); east on Highway 401; north on Highway 10 to LF-2N
- *2. west on Britannia Road (Halton Regional Road 6); north on Tremaine Road (Halton Regional Road 22); east on Steeles Avenue (Halton Regional Road 8); north on Highway 25; east on Highway 401; north on Highway 10 to LF-2N

TABLE 4.2
OWMC PHASE 4A - TRANSPORTATION
ACCESS ROUTE OPTIONS CONSIDERED IN PRELIMINARY PHASE 4A
(continued)

LF-2N/PI-13N
to PI-13N (from north)

1. from 401 - south on Fourth Line (partly Halton Regional Road 4); east on Britannia Road (Halton Regional Road 6); south on Fifth Line to PI-13N
- *2. from 401 - south on Fourth Line (Halton Regional Road 4); east on Derry Road (Halton Regional Road 25); south on Fifth Line to PI-13N
- *3. from 401 - south on Trafalgar Road (Halton Regional Road 3); west on Britannia Road (Halton Regional Road 6); south on Fifth Line to PI-13N

PI-13N to LF-2N

- *1. north on Fifth Line; east on Britannia Road (Halton Regional Road 6); north on Trafalgar Road (Halton Regional Road 3); east on Highway 401; north on Highway 10 to LF-2N
2. north on Fifth Line; west on Britannia Road (Halton Regional Road 6); north on Fourth Line (partly Halton Regional Road 4); east on Highway 401; north on Highway 10 to LF-2N
- *3. north on Fifth Line; west on Derry Road (Halton Regional Road 25); north on Fourth Line (Halton Regional Road 4); east on Highway 401; north on Highway 10 to LF-2N
- *4. north on Fifth Line; east on Britannia Road (Halton Regional Road 6); north on Trafalgar Road (Halton Regional Road 3); east on Derry Road (Halton Regional Road 25, and Peel Regional Road 5) to LF-2N

LF-4N/PI-1N
to LF-4N

1. from 401 - south on Fourth Line (partly Halton Regional Road 4); west on Britannia Road (Halton Regional Road 6) to LF-4N
- *2. from 401 - south on Fourth Line (Halton regional Road 4); west on Derry Road (Halton Regional Road 25); south on Highway 25; west on Britannia Road (Halton Regional Road 6) to LF-4N

TABLE 4.2
OWMC PHASE 4A - TRANSPORTATION
ACCESS ROUTE OPTIONS CONSIDERED IN PRELIMINARY PHASE 4A
(continued)

LF-1E/PI-27E
PI-27E to LF-1E

1. east on Niagara Regional Road 47 (Biggar Road); south on Niagara Regional Road 98 (Montrose Road); west on Carl Road to LF-1E
- *2. west on Niagara Regional Road 47 (Biggar Road); south on Morris Road to LF-1E
3. west on Niagara Regional Road 47 (Biggar Road); south on Crowland Ave.
4. east on Niagara Regional Road 47 (Biggar Road); south on Niagara Regional Road 98 (Montrose Road); west on Young Road to LF-1E
5. east on Niagara Regional Road 47 (Biggar Road); south on Montrose Road (Niagara Regional Road 98); west on Schisler Road (Niagara Road 27) to LF-1E

NOTE: * Option(s) eliminated in preliminary Phase 4A analysis.

to the preliminary Phase 4A analysis. However, the accident rate for regional roads and provincial highways was based on the actual rate between 1980 and 1982. Since local roads were expected to be upgraded as part of the OWMC facility construction to provide roads structurally and geometrically equivalent to provincial secondary highways, the provincial average accident rate for secondary highways was applied. These changes in methodology are described in Chapter 2.

This factor and indicators were applied to represent the possibility of the occurrence of an event which could affect the environment or human health of those nearby. The consequences of these events were represented by factors and indicators applied by other consultants.

2.3 ASSUMPTIONS

During the preliminary Phase 4A access road option comparison a number of assumptions were made in order to establish values for the indicators to be applied. This subsection discusses these assumptions and their effect on the transportation analysis.

The values of the transportation indicators applied to the preliminary comparison were dependent upon the site entrance location. During the early part of Phase 4A the preferred entry point had not been determined, therefore it was necessary to assume an entry point for each candidate site. If the assumed entry point selected in the preliminary access route comparison was significantly altered due to other considerations in the Phase 4A investigations this would be reflected in the Phase 4A access road option comparisons. None of the changes to the site entry point were significant enough to warrant a re-examination of the results of the preliminary access route option comparison.

2.4 EVALUATION OF PRELIMINARY ROAD ACCESS OPTIONS

The access road options were compared in terms of the indicators associated with the Transport Safety factor. The indicator values are shown in Table 2 of Appendix A of the Transportation Technical Appendices. No formal scaling or weighting of indicators was carried out at this stage of the analysis, however the access road options were ranked according to the transportation safety indicators listed earlier.

Table 4.3 lists the access road options in order of preference with respect to the transportation safety indicators. A rationale for these rankings is also provided. The table also indicates which options were eliminated through the synthesis of all data provided by the site selection team. This preliminary elimination process is described in the Site Selection report (Dillon, 1985).

3. PHASE 4A ACCESS ROAD OPTIONS COMPARISON METHODOLOGY

3.1 INTRODUCTION

The access road options remaining after the preliminary access road option comparison were carried into the Phase 4A access road option comparison. The access road options were affected by the refinement of the site boundaries, and as a result a number of options were modified, added or deleted depending upon the ability of the options to access the plant facilities on-site.

The transportation factors and indicators used in the preliminary assessment of the access road options were modified for the Phase 4A analysis. Certain indicators under the Transportation Safety factor were screened, and a road improvement cost factor was added.

TABLE 4.3
OWMC PHASE 4A - TRANSPORTATION
RANKING OF PRELIMINARY ACCESS ROAD OPTIONS

<u>Site</u>	<u>Ranked Order of Preliminary Access Road Options¹</u>	<u>Rationale for Ranking</u>
LF-3C	6 1 2* 4* 3* 5*	. Options 6 and 1 are highest ranked because these have the lowest accident rates, no level rail crossings, and few intersection turns. Option 6 slightly preferred due to lower accident rate . Other option are similar, however Option 5 not preferred due to two level rail crossings involved
LF-9C	1 2* 3*	. Option 1 preferred due to lower accident rate, no level rail crossings, shorter distance, and fewer turns . Other two options are very similar, Option 2 preferred slightly due to accident rate and route length
LF-1E	1 4 5 3 2*	. All options are similar, however Option 2 is least preferred because it includes 2 level railway crossings . Options 1, 4 and 5 have no level rail crossings
PI-1N	2* 1	. Option 2 slightly preferred due to lower accident rate
PI-1N to LF-2N	1 2*	. Option 1 preferred due to lower accident rate, fewer turns and level rail crossings

TABLE 4.3
OWMC PHASE 4A - TRANSPORTATION
RANKING OF PRELIMINARY ACCESS ROAD OPTIONS
(continued)

<u>Site</u>	<u>Ranked Order of Preliminary Access Road Options¹</u>	<u>Rationale for Ranking</u>
PI-13N	2* 3* 1	. All options are very similar, slight preference for Option 2 due to lower accident rate
PI-13N to LF-2N	3* 2 1* 4*	. Options 1, 2 and 3 are all similar. Option 4 is least preferred due to highest accident rate
LF-4N	2* 1	. Option 2 slightly preferred due to lower accident rate
PI-27E to LF-1E	1 4 5 3 2*	. All options are similar, however, Option 2 is least preferred because it includes 2 level railway crossings

NOTES: * Indicates options eliminated in preliminary investigation - rationale for elimination is contained in the Site Selection report (Dillon 1985).

1. Option numbers refer to numbers shown in Table 4.2.

The access road options for those candidate sites wherein no final selection could be made during the preliminary analysis are tabulated in Table 4.4. Reference should also be made to Figures 4.1 through 4.12 where the legend identifies those access route options which were evaluated and compared at this stage.

The final selection of a preferred access road option involved the synthesis of all the factors applied by the consultants within the site selection team. The documentation of the synthesis is described in the Phase 4A Site Selection report (Dillon, 1985).

3.2 FRAMEWORK AND ASSUMPTIONS

The local and regional access road options analysis was a comparative study of the possible access routes to the candidate sites. A number of these routes were identified in the preliminary analysis and it was concluded that further investigation was required.

The transportation analysis investigated the access roads in terms of existing safety, structural adequacy, roadway capacity and noise impact corridors as illustrated in Figure 4.13. Assumptions were necessary during this stage of analysis, however these assumptions affected all options equally and did not affect the comparative results of the study.

3.2.1 Road improvement costs

For the purpose of estimating the cost of upgrading the existing roads to physically accommodate the traffic generated by the OWMC facilities the following assumptions were made:

TABLE 4.4
OWMC PHASE 4A - TRANSPORTATION
ACCESS ROUTE OPTIONS CONSIDERED IN PHASE 4A ANALYSIS

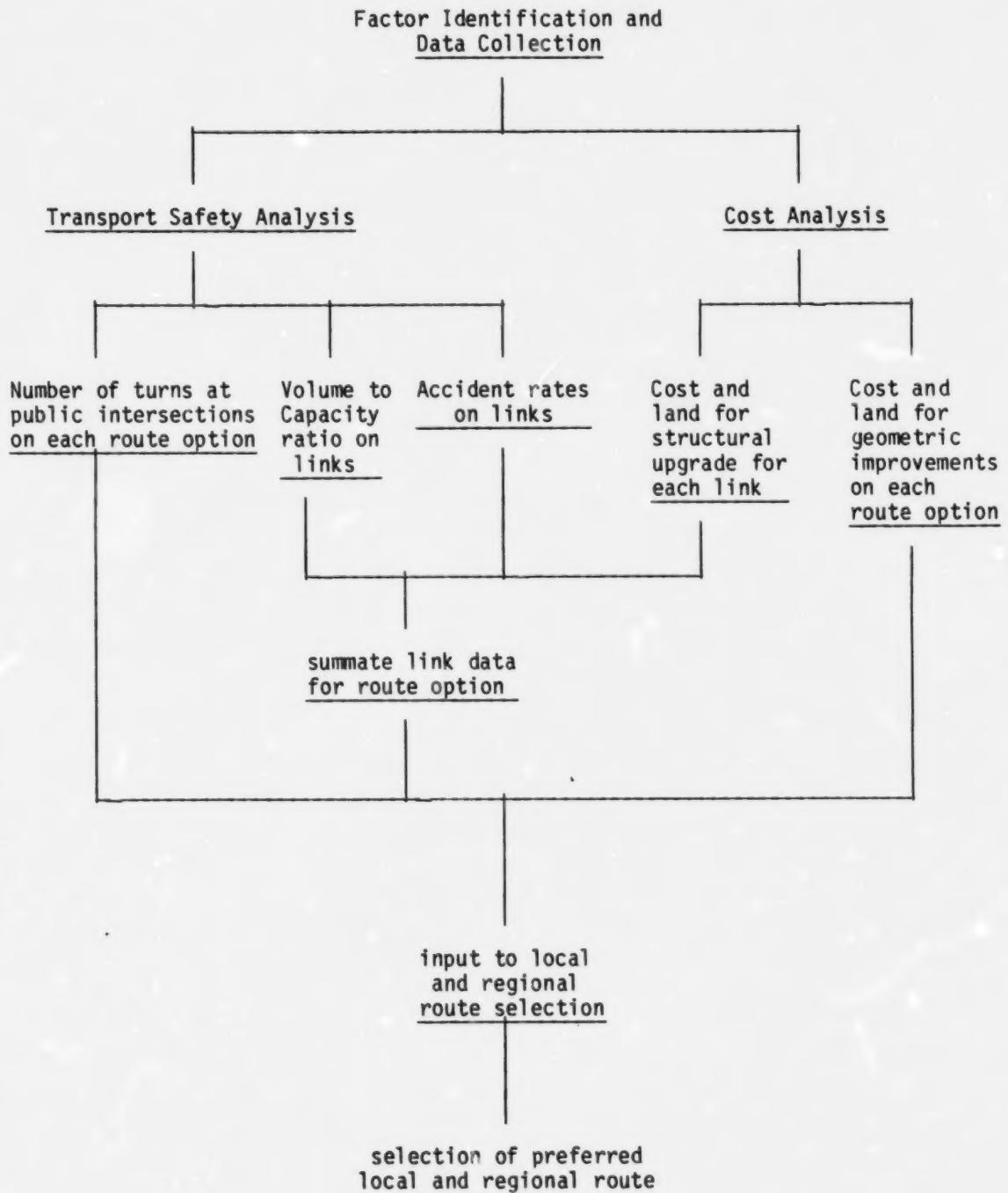
LF-3C

1. from QEW - south on Vineland Townline Road (Niagara Regional Road 24); west on Highway 20; south on Niagara Regional Road 27; west on Elcho Road; south on Krick Road to LF-3C
- +2. from QEW - south on Vineland Townline Road (Niagara Regional Road 24); west on Highway 20; west on Niagara Regional Road 65 from Bismarck; south on Krick Road to LF-3C

LF-1E

1. from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road); south on Niagara Regional Road 98 (Montrose Road); west on Carl Road to LF-1E (enter site at Morris Road)
2. from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road); south on Crowland Ave. to LF-1E (enter site midway between Carl and Young Roads)
- 3.¹ from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road); south on Montrose Road (Niagara Regional Road 98); west on Young Road to LF-1E (enter site at Crowland Ave.)
- 4.¹ from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road); south on Montrose Road (Niagara Regional Road 98); west on Schisler Road (Regional Road 27) to LF-1E (enter site at Crowland Ave.)
- +5. from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road); south on Crowland Road; west on Carl Road to LF-1E (enter site at Morris Road)
6. from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road); south on Montrose Road (Niagara Regional Road 98); west on Carl Road; south on Crowland Ave. to LF-1E (enter site midway between Carl and Young Roads)

FIGURE 4.13
OWMC PHASE 4A TRANSPORTATION
ACCESS ROAD SELECTION FRAMEWORK



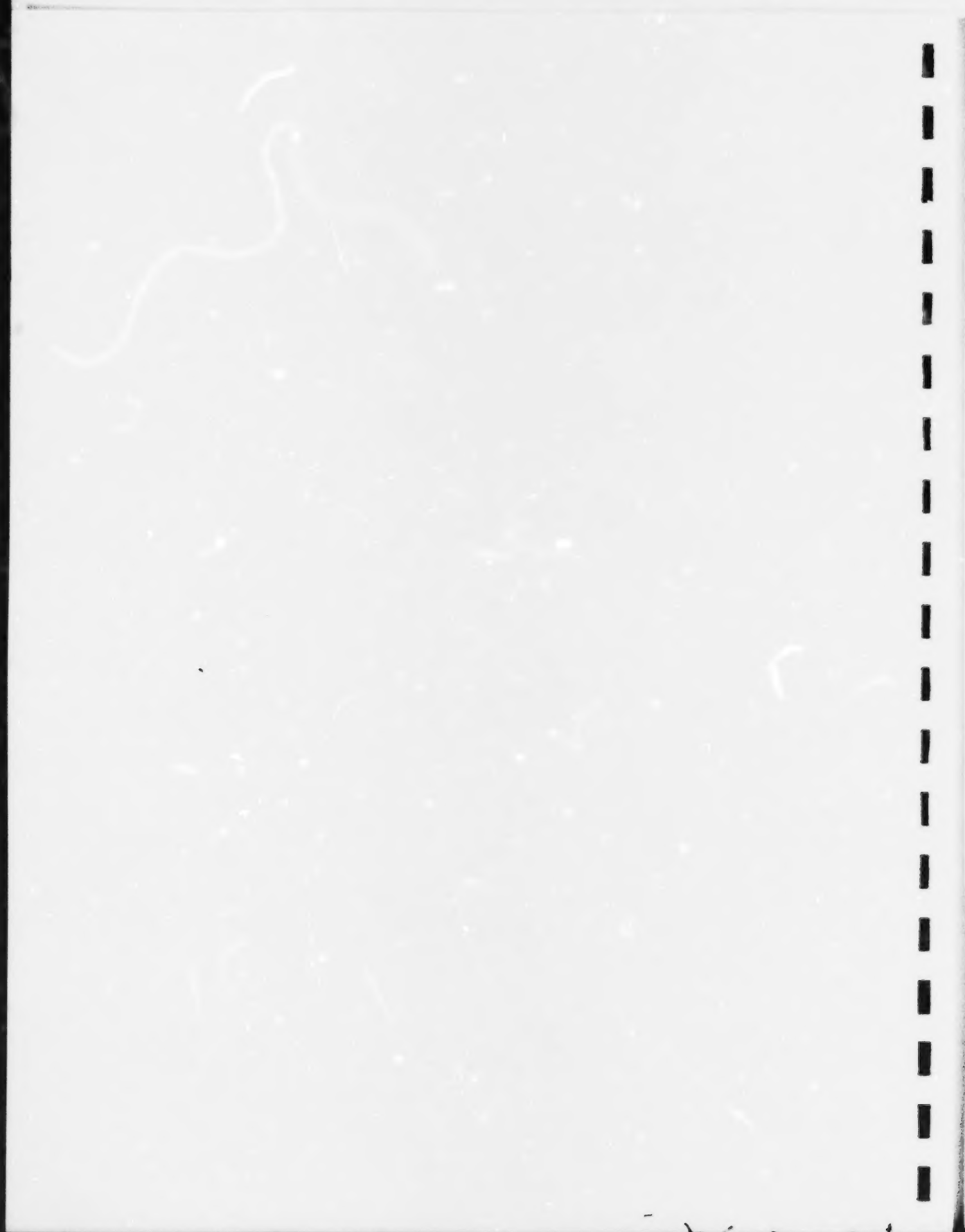


TABLE 4.4
OWMC PHASE 4A - TRANSPORTATION
ACCESS ROUTE OPTIONS CONSIDERED IN PHASE 4A ANALYSIS
(continued)

LF-4N/PI-1N
PI-1N to LF-4N

1. north on Highway 25 (Bronte Road); west on Britannia Road (Halton Regional Road 6) to LF-4N
- +2. north on First Line; west on Britannia Road (Halton Regional Road 6) to LF-4N

LF-1E/PI-27E
to PI-27E

- +1. from QEW - west on Niagara Regional Road 47 (Lyons Creek Road/Biggar Road) to PI-27E
2. from QEW - west on Niagara Regional Road 47; north on Regional Road 98 to PI-27E

PI-27E to LF-1E

1. east on Niagara Regional Road 47 (Biggar Road); south on Niagara Regional Road 98 (Montrose Road); west on Carl Road to LF-1E
2. west on Niagara Regional Road 47 (Biggar Road); south on Crowland Ave. to LF-1E
- 3.¹ east on Niagara Regional Road 47 (Biggar Road); south on Montrose Road (Niagara Regional Road 98); west on Young Road to LF-1E
- 4.¹ east on Niagara Regional Road 47 (Biggar Road); south on Montrose Road (Niagara Regional Road 98); west on Schisler Road (Niagara Regional Road 27) to LF-1E
- +5. west on Niagara Regional Road 47 (Biggar Road); south on Crowland Ave.; west on Carl Road to LF-1E
6. east on Niagara Regional Road 47 (Biggar Road); south on Montrose Road (Niagara Regional Road 98); west on Carl Road; south on Crowland Ave. to LF-1E

NOTES: + Selected as preferred access route through synthesis of all data prepared by the Site Selection team.

1. These routes eliminated after boundary refinements since they did not provide access to treatment facilities.

- ° 180 trucks two-way daily, 250 days per year would be generated by an OWMC facility at 300 000 tonnes per annum of special waste;
- ° any upgrading of the existing roads to satisfactorily accommodate the existing traffic will be done by the road authority responsible.

The preliminary estimate of 180 trucks two-way per working day to the OWMC facilities was later proven to be a reasonable estimate following a more comprehensive examination of the truck movements involved with the waste stream and treatment process (see Appendix G of the Transportation Technical Appendices).

The existing sub-base structure of the roadways could not be determined without extensive field testing along all the access routes. Therefore, it was not possible to determine the adequacy of the present structural support provided for the existing traffic without OWMC generated trucks. However, it was assumed that the road would be upgraded by the road authority responsible, to provide an adequate pavement structure to serve existing vehicle usage when required. Any additional cost required to upgrade the roadway to support the additional OWMC generated trucks was calculated.

The cost of road upgrading does not include the cost of constructing a site entrance from the existing roadways. Since all sites will have the same basic entrance requirements the cost of implementing each entrance is assumed to be equivalent for all access options. This cost factor was included during the comparison of siting options as discussed in Chapter 8.

3.2.2 Accident rates

The routes' accident experience were used as an indicator to the Transport Safety factor. For most of the roadways, the cumulative 1980-1982 accident experience, the road link length, and the

average daily traffic volumes were used to estimate the average annual number of accidents per million vehicles for each access route. However, such traffic information was not readily available for roadways under local government jurisdictions, therefore an accident rate was assumed for these roads.

The estimated rate differs from the assumed rate used in Phase 3B. It was assumed that since the local roads near the site would require upgrading, when the OWMC site is constructed, the accident rate should reflect the improved status of the roadways. The new road geometrics and structural capabilities will be equal to or better than the provincial secondary highway standard therefore the accident rate for the local roads was assumed to be equivalent to the five-year average secondary highway accident rate (1.61 accidents per million vehicle-kilometres) for the years 1978-1982.

Further discussion of this assumption is presented in Chapter 2.

3.3 IDENTIFICATION OF PHASE 4A FACTORS AND INDICATORS

The transportation factors and indicators applied to the Phase 4A access road option comparison are shown in Table 4.5.

A number of indicators applied in the preliminary analysis were screened for the Phase 4A comparative study while others were added. Table 4.5 therefore provides a summary of the rationale for the screening and addition of factors and indicators for the Phase 4A access road option comparison.

Within the transportation risk factor grouping, the Transportation Safety and Probability of Transport Accidents factor was applied. This factor was represented by three indicators:

TABLE 4.5
OWMC PHASE 4A - TRANSPORTATION
RATIONALE FOR SELECTION OF FACTORS AND INDICATORS
FOR PHASE 4A ACCESS ROAD SELECTION

<u>Factor/Indicators</u>	<u>Status in Phase 4A Comparison</u>			<u>Rationale for Status</u>
	<u>Screened</u>	<u>Maintained</u>	<u>Added</u>	
<u>Transport Safety</u>				
a) Proximity to arterial roads	X			. Local roads will be upgraded to arterial standards - accounted for in cost factor
b) Number of level rail crossings on local roads	X			. No occurrence in any options
c) Accidents/million vehicles		X		. Represents event potential portion of transportation risks
d) Distance to freeway	X			. Safety of access route is better represented by accidents, and volume to capacity ratio
e) Total number of rail crossings	X			. No difference among options to some sites
f) Number of inter-sections where turn is required		X		. Represents a component of transport safety
g) Range of existing volume to capacity (v/c) ratio along route			X	. Represents present roads capability to operate satisfactorily
<u>Road Improvement Costs</u>				
a) Preliminary estimate of improvement construction costs			X	. Indicates capital costs to provide an adequate access route
b) Amount of additional land for road right-of-way			X	. Represents additional cost to upgrading existing roads to meet OWMC transport needs

- ° composite annual accident rate (accidents/million vehicles),
- ° the number of public intersections where a turn is required,
- ° the range of peak hour volume to capacity (V/C) ratios along the route.

The composite annual accident rate along each access route option provided a means of comparing routes in terms of the possibility of an accident or spill along the route. Access routes with a higher number of accidents per million vehicles would also have a higher spill probability than those with a lower accident value.

Intersection turns can pose difficulties for heavy trucks. Present geometrics at these intersections may be inadequate for heavy truck manoeuvres which may result in the trucks encroachment onto opposing lanes or shoulders. At this stage of the analysis no costs have been assigned to the improvement of intersections along the access route options except for jog eliminations. To determine a cost value for intersectional improvements would require a detailed analysis of future turning movement demand at each intersection. These data were not available at the time of this analysis but should be developed for the preferred site(s) in Phase 4B.

The V/C ratio is an indicator of the roadway's present operating condition. Ratios which approach 1.0 indicate high traffic density and congestion on the road section. Roadway sections with a V/C ratio approaching 0.9, demonstrate a need for roadway widenings in the near term.

From the factor grouping Transportation Costs, the transportation factor Road Improvement Costs was applied to the selection of access routes. This factor was represented by these indicators: "preliminary estimated improvement construction costs", and "amount of additional land required for road right-of-way".

The existing roadways may need to be improved in order to accommodate the additional heavy truck volumes expected on the local and regional access routes. The preliminary cost for improving the pavement structure and road cross sections on the access roads will be a consideration in selecting the appropriate route.

In some cases it is necessary to purchase additional land to accommodate geometric improvements, to provide adequate right-of-way along access routes, or for jog eliminations at intersections. The cost of this land acquisition is dependent upon the current land market values; therefore only the area (hectares) of land required has been tabulated as land values for specific land acquisitions was not readily available. It was assumed that the cost of land acquisition would be a minor component of overall road improvement cost. This assumption later proved to be correct as demonstrated by the sensitivity analysis undertaken later in this Chapter.

3.4 INFORMATION SUPPLIED TO OTHER CONSULTANTS

3.4.1 Road noise corridor identification

S.S. Wilson Associates, sub-consultant to the transportation consultant, provided a preliminary definition of a noise impact

corridor based on existing background traffic levels, the heavy commercial vehicle percentage, and a preliminary estimate of OWMC generated heavy truck movements provided by the transportation consultant. These guidelines, reported in Appendix L of the Transportation Technical Appendices, were then provided to the Institute of Environmental Research for application to access road evaluation.

It is not intended to apply these general guidelines (see Appendix L) to the comparative analysis of siting options; however, it is a reasonable and consistent basis of comparison for access route option evaluation. For detailed comparative evaluation, noise measurements and forecasts will be made along the identified preferred access route to each candidate site.

4. PHASE 4A DATA COLLECTION AND ANALYSIS

The information required to analyze the local and regional access route options was collected through field investigations and by contacting various roadway agencies responsible for the roads' operation. Following the data collection the information was applied to the various factors and indicators used in comparing the access route options.

The data collection and field investigations conducted to provide data inputs for the evaluation of access route options is presented in Chapter 2 of this report.

4.1 METHOD OF ANALYSES

Following the collection of information through field investigations and agency contacts, the data were analyzed for use as

inputs to the factors and indicators used in the evaluation of the access route options. There were four transportation indicators used in evaluating the access routes which required further analysis following data collection:

- ° composite annual accident rate of each road option;
- ° the range of peak hour volume to capacity (V/C) ratios on links along the access route;
- ° improvement construction costs;
- ° amount of additional off-site land required for road improvement.

The indicator "number of intersections where a turn is required" did not require any further analysis after data collection.

4.1.1 Composite accident rate

The first step in compiling the composite accident rate was to modify the accident data to a common value for each link along the route. Therefore, it was necessary to convert the 1980 to 1982 data to reflect the number of accidents based on vehicle exposure. The data were compiled to have the dimensions: number of accidents per million vehicle-kilometres.

The accident data was calculated for the various links along the local and regional access routes according to the following formula:

$$\frac{\text{three year total number of accidents on link}}{\text{link length} \times \text{sum of 3 years of AADT on link} \times 365} \times 1 \times 10^6$$

= annual average accidents per million vehicles-kilometres on each link

In the route selection portion of Phase 4A investigations, the accident rate for an access route option was calculated by summing all the link accident rates along the route weighted according to the length of each link. These weighted annual average accident data for each option have the dimensions: accidents per million vehicles. This was an acceptable means of comparing different access routes to a site because it gave a good indication of the existing accident potential for each route. A higher accident rate indicated higher potential along that route.

4.1.2 Volume to capacity ratio

The volume to capacity ratio (V/C) was used as an indicator of the quality of transportation operations along the local and regional access roads from a 400-series highway to the candidate site. This indicator was applied, with other transportation indicators, representing transport safety.

The analysis of access road options in terms of their volume to capacity (V/C) ratios provided information on the ability of the existing roadways to carry additional traffic volumes. Roadways which have a high V/C ratio (approaching 1.0), have less spare capacity than those with smaller ratios, and therefore are less able to safely and efficiently accommodate additional traffic. If the V/C ratio exceeds 1.0, then the volume of traffic on the roadway exceeds that for which the road was designed. In cases where the V/C ratio exceeds 1.0, immediate remedial action is required. Such action can include widening of the existing lanes, the addition of new lanes to relieve the traffic congestion, etc.

The analysis of the capacity of the various local and regional access routes to candidate sites made use of existing information on the access routes which was supplied by the appropriate

municipal or provincial agencies. In some instances, when adequate data were not available, it was necessary to make a number of assumptions regarding the roadways' operation based on existing information.

The methodology used to calculate the roadway capacities was based on the method described in the Ontario Ministry of Transportation and Communication's Inventory Manual for Municipal Roads and Structures, published July 1978. This method calculates capacity based on the following factors:

- ° number of lanes
- ° lane width
- ° shoulder width
- ° percent of trucks in traffic stream
- ° relative frequency of driveway entrances

The analysis worksheets for calculating the V/C ratio's on all the local and regional access route options are held on file at the offices of the transportation consultant and only the results are reported herein.

When all the appropriate data were collected or estimated, the V/C ratio was calculated by simply dividing the design hour volume of the roadway by the hourly capacity. Each roadway can be placed in a specific category according to the V/C ratio value.

4.1.3 Preliminary estimate of road improvement construction costs

The improvement construction cost indicator applied to the comparison of local and regional access routes included the cost of upgrading the roadways to provide adequate road pavement

structure strength to support the additional number of heavy trucks expected to be generated by the OWMC facility. It also included costs for improving major roadway geometric deficiencies along the access route option, such as intersectional jog eliminations.

The methodology applied to estimating the structural improvements required incorporating as much structural design theory as possible while avoiding excessive data collection. Since it was not possible to gather data regarding the physical structural composition of the roadway, it was assumed that the roads were constructed in accordance to MTC guidelines for flexible pavements.

The amount of upgrading required along a link was calculated based on the difference between the structural requirements with and without OWMC generated vehicles. To estimate the required structural composition of a given link it was assumed that the road must be built to accommodate an AADT equivalent to ten times the number of heavy trucks using the roadway. The MTC guidelines were then used to estimate the structural conditions necessary to support this AADT.

The existing structural conditions were estimated based on the 1983 AADT and percent heavy trucks. The conditions necessary to support the existing traffic and OWMC was estimated by adding the estimated number of OWMC generated vehicles using the route to the 1983 data. The road improvements required were estimated to be the difference between these two structural conditions.

The cost of improving the roadway was based on the most recent 'benchmark cost' derived by the road agencies and was used only on a comparative basis.

Improvements to road alignments and certain other deficiencies identified in the field investigation were also included. The estimated cost of these improvements is shown in Table 4.6.

Since the route selection stage took place prior to the finalization of the detailed analysis of OWMC generated truck movements, a number of assumptions needed to be made with respect to the added amount of truck traffic on the local and regional access roads between the 400-series and the candidate site:

- ° Number of trucks arriving and departing based on five days a week operation: (includes wastes, inter-site transfers, additives and reagents) 180 trucks/working day
- ° Equivalent AADT volume on access route: 123 trucks
- ° Portion of trucks arriving and departing Milton sites
 - from 401: 2/3
 - from QEW: 1/3

During the detailed comparative analysis stage these preliminary estimates were updated to reflect the final results of the truck movement analysis obtained from the modelling process. Appendix H in the Transportation Technical Appendices summarizes the trucking calculations used to calculate the cost of road improvements for the detailed comparative evaluation.

Additional land was required in order to maintain a minimum 20.0 m wide right-of-way. If the road section's right-of-way was less than 20.0 m, the additional area of land to be purchased would be calculated for the length of the section. Additional land was also required to accommodate the implementation of jog eliminations where these are required.

TABLE 4.6
OWMC PHASE 4A - TRANSPORTATION
SPOT IMPROVEMENTS INCLUDED IN ROAD IMPROVEMENT COSTS
FOR LOCAL AND REGIONAL ACCESS ROUTE SELECTION

<u>Jurisdiction and Road Section</u>	<u>Improvement Description</u>	<u>Cost¹ in 1984 \$</u>
Halton Region		
° Regional Road #8 (road section 8309)	Bridge over 16 Mile Creek	\$150,000
° Regional Road #6 (road section 6309)	Jog elimination at Tremaine Road	\$ 38,000
Niagara Region		
° Regional Road #47 (road section 4707)	Level crossing improvement at intersection of Crowland Ave. and Regional Road 47	\$160,000
City of Niagara Falls		
° Crowland Avenue (road section 60011)	Road realignment at rail- way crossing at inter- section of Crowland Avenue and Biggar Road	\$250,000
Township of West Lincoln		
° Krick Road (road section 131)	New bridge construction	\$ 50,000

NOTE: 1. Excludes property acquisition cost.

The cost of the additional land required outside the road's existing right-of-way was not estimated for each option since it depended upon the current land values. However, the area of additional land required was estimated and used as an input to the Road Improvement Cost factor. A detailed estimate of land costs for the preferred access route was undertaken and the results are presented at the conclusion of this chapter.

4.2 IMPACT OF SITE BOUNDARY REFINEMENTS ON ACCESS ROAD OPTIONS

The site investigations carried out during Phase 4A lead to the refinement of the boundaries at certain candidate sites (see Chapter 3). At candidate sites PI-1N, LF-1E and LF-3C, the boundary refinements affected data concerning the access route options for the site. Table 4.7 lists the various site access and transfer routes options affected by the site boundary refinements after the preliminary access route analysis.

4.3 RESULTS OF ANALYSIS

Table 4.8 summarizes the values of the indicators applied to the selection of local and regional access route options at each of the candidate sites where an option was presented. The access routes to or between the following sites were not examined in the Phase 4A analysis because routes were selected during Phase 3B, or Preliminary Phase 4A:

- ° LF-2N
- ° PI-1N
- ° LF-9C
- ° PI-13N to LF-4N
- ° PI-1N to LF-2N
- ° PI-13N to LF-2N

TABLE 4.7
OWMC PHASE 4A - TRANSPORTATION
EFFECT OF SITE BOUNDARY REFINEMENTS ON ACCESS ROUTE OPTIONS

<u>Site</u>	<u>Change in Access Route from Preliminary Study due to Site Boundary Refinements</u>	<u>Effect of Site Boundary Refinements on Transport Analysis</u>
LF-3C	° Site entry defined as Krick Road 0.7 km south of Elcho Road	° Increases accident frequency value ° Phase 4A option 1 becomes longer than the similar preliminary option 1 ° Does not affect preliminary access route results
LF-1E	° Site entries defined as the intersection of Morris Road and Carl Road or Crowland Ave. between Carl and Young Roads	° Eliminates Phase 4A option 3 and 4 because they do not provide access to these points ° Phase 4A option 2 becomes longer than the similar preliminary option 3 ° Two new options introduced: Phase 4A options 5 and 6
PI-1N	° Provide access to First Line for transfer movements to LF-4N	° Introduces new transfer route option between LF-4N and PI-1N

TABLE 4.8
OWMC PHASE 4A - TRANSPORTATION
DATA FOR COMPARATIVE EVALUATION OF LOCAL AND REGIONAL ACCESS ROUTE OPTIONS

Factors/Indicators	PI-27E to LF-1E2			SITE LF-3C	
	Option 1	Option 2	Option 5	Option 6	Option 1 2
A. Transport Safety					
Accidents/million vehicles	8.07	4.63	5.11	9.59	52.96 47.91
Intersection Turns	2	1	2	3	4 2 ¹
V/C Ratio Range	0.0-0.4	0.0-0.4	0.0-0.4	0.0-0.4	0-.6 0-.6
B. Road Improvement Costs					
Road Construction (in \$1000's)	246.4	672.7	693.2	226.4	453 1,147
Right-of-Way required (hectares)	Ni1	0.04	0.04	Ni1	Ni1 1.43

TABLE 4.8
OWMC PHASE 4A - TRANSPORTATION
DATA FOR COMPARATIVE EVALUATION OF LOCAL AND REGIONAL ACCESS ROUTE OPTIONS
(continued)

Factors/Indicators	LF-1E ²						PI-27E		PI-1N to LF-4N	
	Option 1	Option 2	Option 5	Option 6	Option 1	Option 2	Option 1	Option 2	Option 1	Option 2
A. Transport Safety										
Accidents/million vehicles	7.95	5.55	6.03	9.47	1.96	2.54	26.68	19.43		
Intersection Turns	2	1	2	3	0	1	3	1	3	1
V/C Ratio Range	0.0-0.4	0.0-0.4	0.0-0.4	0.0-0.4	0.0-0.3	0.3-0.4	0.0-0.5	0.0-0.1		
B. Road Improvement Costs										
Road Construction (in \$1000's)	171.0	672.7	693.2	151.0	113.0	0	245.4	278.4		
Right-of-Way required (hectares)	Nil	0.4	0.4	Nil	Nil	Nil	0.2	0.2		

- NOTES:
1. Six turns required; was reduced to two turns as improvements allow for two jog eliminations and cost for this is included.
 2. Selected route to LF-1E will also be used for transfer between PI-27E and LF-1E.
 3. Number of turns required was reduced through jog elimination and costs for this is included in road improvement costs.

5. RANKING AND AGGREGATION OF PHASE 4A FACTORS AND INDICATORS

5.1 SCREENING OF FACTORS AND INDICATORS

After an examination of the data collected for the Phase 4A analysis, a number of indicators were screened from the comparison of access road options at each site. Table 4.9 provides the rationale for the screening of the indicators.

OWMC PHASE 4A - TRANSPORTATION
TABLE 4.9
SCREENING OF INDICATORS

<u>Site</u>	<u>Indicators Screened</u>	<u>Rationale</u>
LF-3C	° v/c ratio range ¹	° Both options have same v/c range
LF-1E	° v/c ratio range ¹	° All options have same value
PI-27E	° Amount of additional land for right-of-way required	° No occurrence in either option
PI-1N to LF-4N	° Number of intersection turns	° Equal values for both options
	° Amount of Additional land for right-of-way required	° Equal values for both options

NOTE: 1. v/c = volume to capacity ratio (see Section 4.1.2).

5.2 INDICATOR LEVEL OF IMPORTANCE

The indicators applied to the transportation analysis of the access road options were ranked according to their overall level of importance to the access route selection process. Generally, the indicators related to the Transport Safety factor have a higher level of importance than the cost related indicators.

<u>Level of Importance</u>	<u>Indicator</u>
High	Composite annual accident rate
Medium	Number of public intersection where a turn is required
Medium	Improvement construction costs
Low	The range in peak hour V/C ratio
Low	The amount of additional right-of-way required

The composite annual accident rate has the highest importance since it relates directly to the safety of each local and regional access route. Risk to human health is the most important goal of this process.

The number of turning movements is of lesser importance than the accident rate since the accident rate accounts for the historical frequency of an accident at an intersection to some degree. However, it is reasonable to assume that the possibility of an accident may increase as the number of turns increases due to the additional vehicle conflicts that would occur.

Improvement construction costs have medium importance since they largely represent the financial aspects of the process. However they also represent the cost of mitigating problems related to access road safety and adequacy.

The V/C ratio was given a low importance level because it was a mitigatable condition which could be ameliorated by increasing the road's capacity. Such improvements can be represented by financial indicators although there was no apparent need to do so.

The amount of land acquisition was given a low importance level since the road improvement costs are viewed to be of greater financial significance than the small amount of additional right-of-way that must be purchased to upgrade the width of roadway allowance or eliminate an intersectional jog.

5.3 SCALING OF INDICATORS

The scaling process involves transforming physical units of measurement into units of desirability to facilitate the aggregation of indicators. In the transportation analysis, a three-level scaling process was applied by dividing the range of indicator value across a set of options into three equal groupings. Each grouping was assigned a scaling value as follows:

<u>Indicator Value Group</u>	<u>Scale Value</u>
High	3
Medium	2
Low	1
No value	0

When only two indicator values were being compared, the significantly higher value was assigned a scaled value of 3; the lower one the value of 1.

Tables 4.10 to 4.13 show the scaled values for the indicators associated with the access route option to be compared for each candidate site. A rationale for these scaled values is also provided.

5.4 AGGREGATION OF FACTORS AND INDICATORS

To provide a consistent basis for aggregating the indicators for the options, numeric values were also assigned to indicator rank importance. Thus, the following weight values were assigned and used in the calculations:

<u>Indicator Rank Importance</u>	<u>Weight Value</u>
High	3
Medium	2
Low	1

TABLE 4.10
OWMC PHASE 4A - TRANSPORTATION
SCALING OF INDICATOR VALUES FOR ACCESS ROAD OPTIONS TO LF-3C

<u>Indicators</u>	<u>Scaled Value for Each Option</u> ¹		<u>Rationale for Scaling</u>
	<u>Option 1</u>	<u>Option 2</u>	
° Accidents per million vehicles	3	1	° A 10% difference between options
° No. of intersection turns	3	1	° Option 1 has 2 more turns than Option 2
° V/C Ratio Range	Indicator screened (see Table 4.9)		
° Road Improvement Cost	1	3	° 60% difference in values
° Amount of Additional Right-of-way required	0	1	° No additional land required for option 1, therefore no scaling value applied

NOTE: 1. Scaling rule for two options noted in Section 5.3.

TABLE 4.11
OWMC PHASE 4A - TRANSPORTATION
SCALING OF INDICATOR VALUES FOR ACCESS ROAD OPTIONS TO LF-1E

<u>Indicators</u>	<u>Scaled Value for Each Option</u>				<u>Rationale for Scaling</u>
	<u>Option 1</u>	<u>Option 2</u>	<u>Option 5</u>	<u>Option 6</u>	
° Accidents/million vehicles	2	1	1	3	° Scaled according to scaling rule 1 below
° No. of intersection turns	2	1	2	3	° Scaled according to scaling rule 2 below
° V/C Ratio Range	Indicator Screened (see Table 4.9)				
° Road Improvement Cost	1	3	3	1	° Scaled according to scaling rule 3 below
° Amount of Additional Right-of-way Required	0	1	1	0	° Same values for options 2 and 5, no value for options 1 and 6

<u>Scaling Rules</u>	<u>Indicator value</u>	<u>Scaled value</u>
1. Accidents/million vehicles	5.55 to 6.86	1
	6.87 to 8.17	2
	8.18 to 9.47	3
2. Number of Turns	3	3
	2	2
	1	1
3. Road Improvement Costs	151.0 to 331.7	1
	331.8 to 512.5	2
	512.6 to 693.2	3

TABLE 4.12
OWMC PHASE 4A - TRANSPORTATION
SCALING OF INDICATOR VALUES FOR ACCESS ROAD OPTIONS TO PI-27E

<u>Indicators</u>	<u>Scaled Value for Each Option</u> ¹		<u>Rationale for Scaling</u>
	<u>Option 1</u>	<u>Option 2</u>	
° Accidents per million vehicles	1	3	° A 20% difference in values
° No. of intersection turns	0	1	° No turns for Option 1, one turn for Option 2
° V/C Ratio Range	1	3	° Range higher for Option 2
° Road Improvement Cost	1	0	° No cost for Option 2
° Amount of Additional Right-of-way required	Indicator Screened (see Table 4.9)		

NOTE: 1. Scaling rule for two options noted in Section 5.3.

TABLE 4.13
OWMC PHASE 4A - TRANSPORTATION
SCALING OF INDICATOR VALUES FOR ACCESS ROAD OPTIONS
BETWEEN PI-1N AND LF-4N

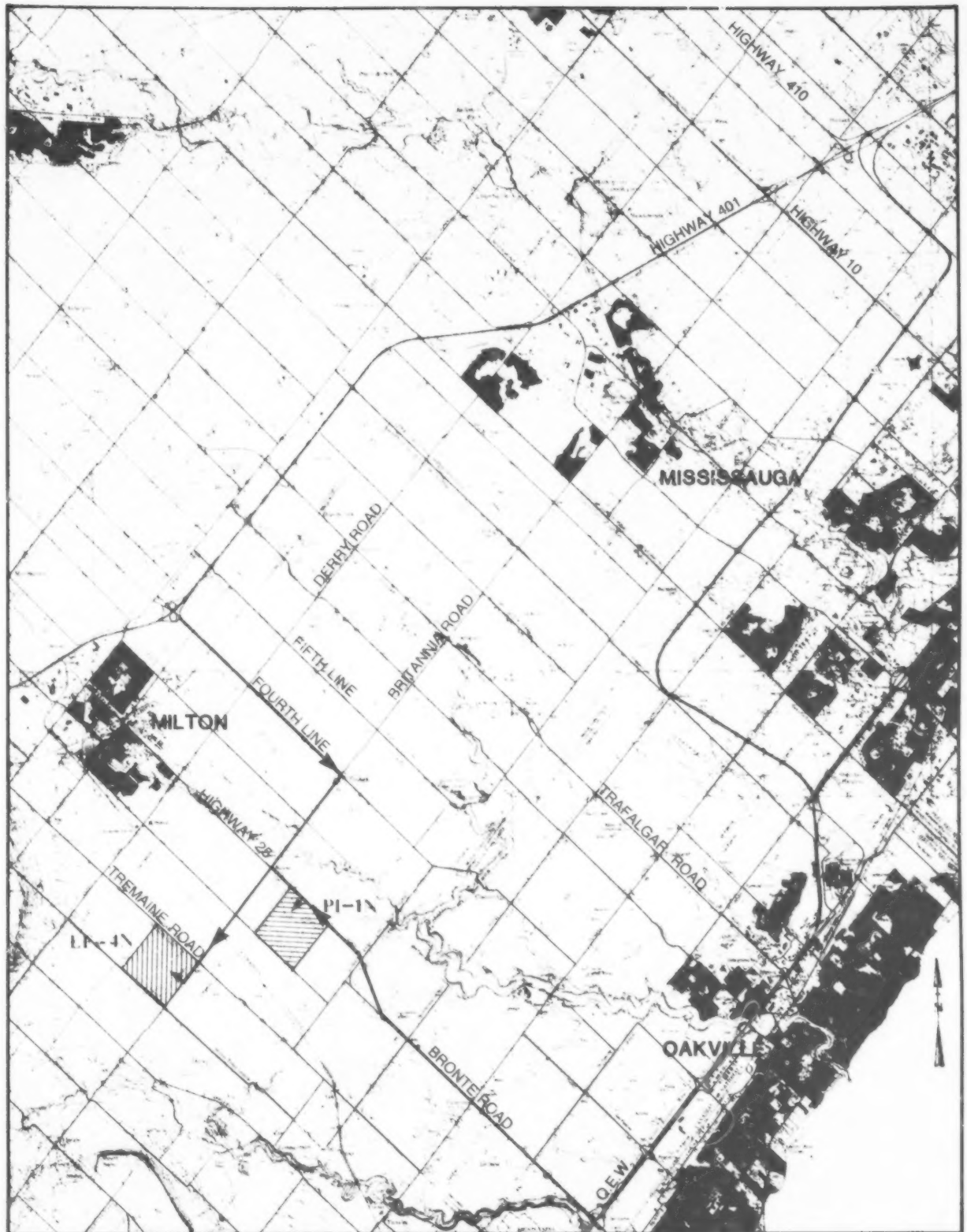
<u>Indicators</u>	<u>Scaled Value for Each Option¹</u>		<u>Rationale for Scaling</u>
	<u>Option 1</u>	<u>Option 2</u>	
° Accidents per million vehicles	3	1	° A 27% difference between options
° No. of intersection turns	Indicator Screened (see Table 4.8)		
° V/C Ratio Range	3	1	° Option 1 has higher range
° Road Improvement Cost	1	3	° A 12% difference between options
° Amount of Additional Right-of-way required	Indicator Screened (see Table 4.9)		

NOTE: 1. Scaling rule for two options noted in Section 5.3.

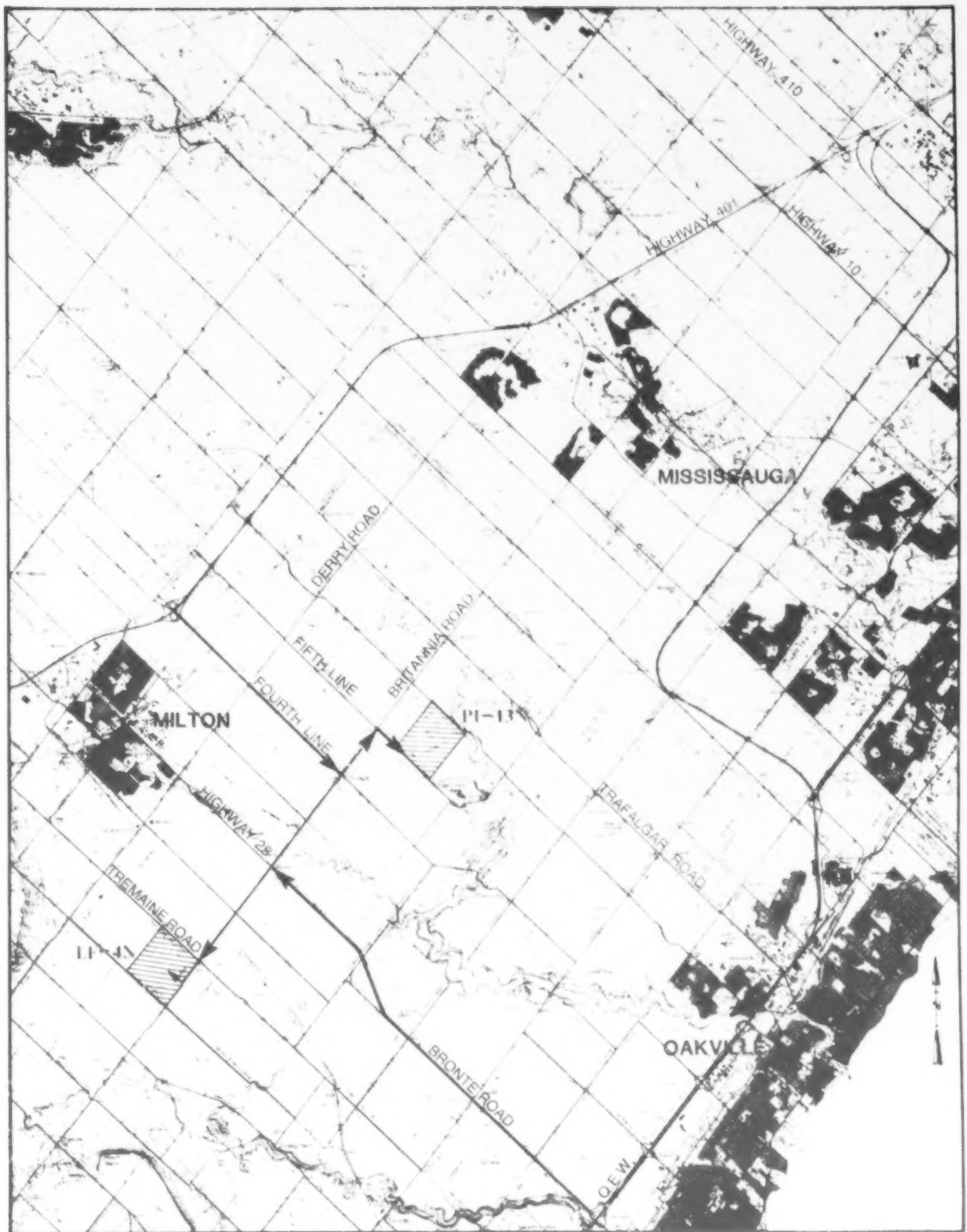


A horizontal scale bar with tick marks at intervals of 1 kilometer, labeled 1, 0, 1, 2, 3, 4, 5. The word "kilometers" is written at the right end.

FIGURE 4.15







OWMCO

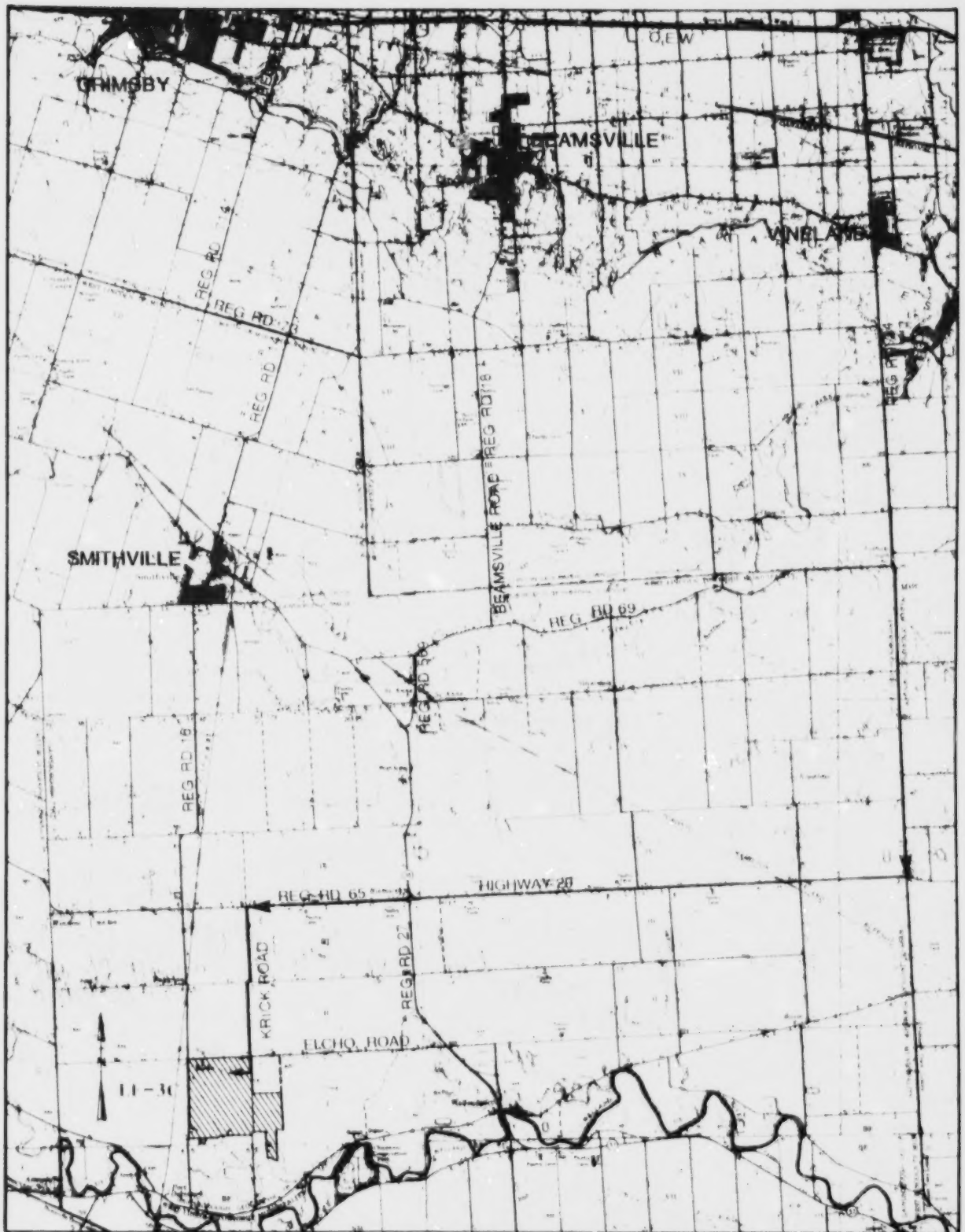
Ontario
Waste Management
Corporation

Consultant

DILLON

PI-13N / LF-4N
PHASE 4A
PREFERRED LOCAL AND REGIONAL ACCESS
FIGURE 4.17

1 0 1 2 3 4 5 kilometers



Ontario
Waste Management
Corporation

Consultant

DILLON

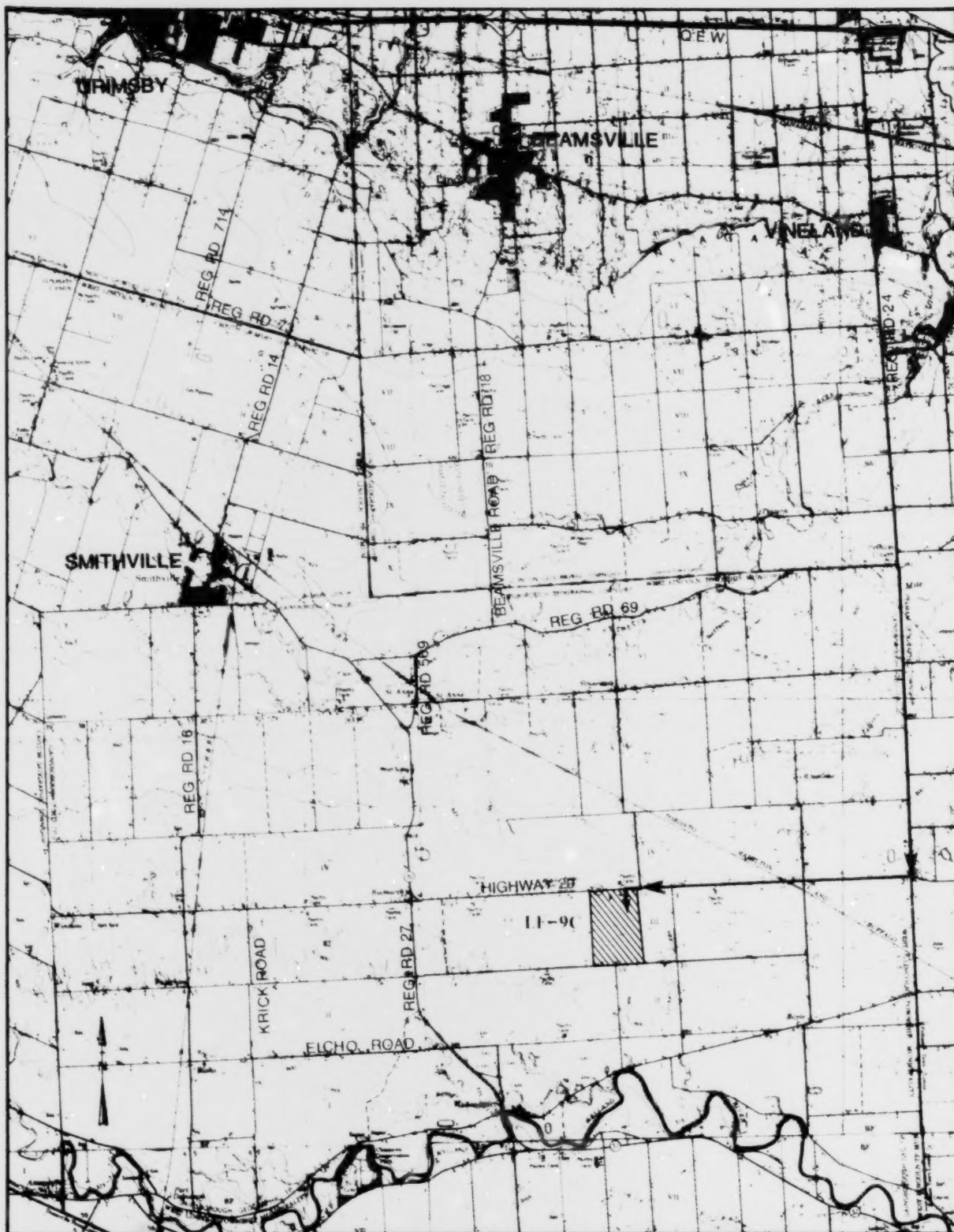
PREFERRED LOCAL AND REGIONAL ACCESS

1 0 1 kilometers

LF-3C

PHASE 4A

FIGURE 4.18



OWMC Ontario
Waste Management
Corporation
Consultant
DILLON

LF-9C
PHASE 4A
PREFERRED LOCAL AND REGIONAL ACCESS
1 0 1 kilometers
FIGURE 4.19



OWM

Ontario
Waste Management
Corporation

Consultant

DILLON

LF-1E AND LF-1E/PI-27E

PHASE 4A

PREFERRED LOCAL AND REGIONAL ACCESS

1 0 1 2 3 4 5 kilometers

FIGURE 4.20

Based upon this system of weights and scale values, a minimum value identifies the best local and regional access route option and the highest value identifies the least preferred option, from the transportation perspective.

The aggregated transportation values for the access route options are shown in Tables 4.14 to 4.17, and reflect the ranking of the transportation factors and indicators discussed in the earlier section. These rankings along with rankings from the other site selection consultants were synthesized to identify the preferred local and regional site access routing.

6. CONCLUSIONS

The inputs provided by all the site selection consultants were considered in selecting the preferred local and regional access route. The methodology employed in the synthesis of these inputs is discussed in detail in the overall Site Selection report (Dillon, 1985). The ranking of access routes contained in the previous section only reflects the comparison of routes from a transportation perspective.

The preferred local and regional access routes for each siting option are identified in Figures 4.14 through 4.20. The selected preferred access routes tended to also be the preferred transportation access routes. The characteristics of the preferred access routes become input to the detailed site comparative analysis stage of the selection process.

The existing conditions on the routes selected, following the synthesis of all the inputs, are presented in Figures 8.1 to 8.3

TABLE 4.14
OWMC PHASE 4A - TRANSPORTATION
TRANSPORTATION RANKING OF LOCAL AND REGIONAL
ACCESS ROUTES TO SITE LF-3C

<u>Factor/Indicators</u>	<u>Indicator Weight</u>	<u>Option Scale Value (Weight x Scale Value)</u>	
		<u>Option 1</u>	<u>Option 2⁺</u>
<u>A. Transport Safety</u>			
Accidents/million vehicles	3	3(9)	1(3)
Intersection Turns	2	3(6)	1(2)
<u>B. Road Improvement Costs</u>			
Road Construction Cost	2	1(2)	3(6)
Amount of Additional Right-of-way Required	1	0(0)	1(1)
Total Comparative Value		17	12
Transportation Rank*		2nd	1st

NOTES: * Rationale for Transportation Ranking: Although costs are higher for Option 2, the preferred transportation option has superior transportation safety features.

+ Preferred route as identified through comparative analysis involving all site selection consultants.

TABLE 4.15
OWMC PHASE 4A - TRANSPORTATION
TRANSPORTATION RANKING OF
LOCAL AND REGIONAL ACCESS ROUTES TO SITE LF-1E

Factor/Indicators	Indicator Weight	Option Scale Value (Weight x Scale Value)			
		Option 1	Option 2	Option 5 ⁺	Option 6
A. <u>Transport Safety</u>					
Accidents/million vehicles	3	2(6)	1(3)	1(3)	3(9)
Intersection Turns	2	2(4)	1(2)	2(4)	3(6)
B. <u>Road Improvement Costs</u>					
Road Construction Cost	2	1(2)	3(6)	3(6)	1(2)
Amount of Additional Right-of-way Required	1	0(0)	1(1)	1(1)	0(0)
Total Comprative Value		12	12	14	17
Transportation Rank*		2nd	1st	3rd	4th

NOTES: * Rationale for Transportation Ranking: Option 2 has superior transport safety features to Option 1 although cost is higher. Option 5 is only slightly costlier than Option 2 with similar transportation safety factors. Option 6 has the poorest transport safety.

+ Preferred route as identified through comparative analysis involving all site selection consultants.

TABLE 4.16
OWMC PHASE 4A - TRANSPORTATION
TRANSPORTATION RANKING OF LOCAL AND REGIONAL ACCESS ROUTES TO PI-27E

<u>Factor/Indicators</u>	<u>Indicator Weight</u>	<u>Option Scale Value (Weight x Scale Value)</u>	
		<u>Option 1⁺</u>	<u>Option 2</u>
<u>A. Transport Safety</u>			
Accidents/million vehicles	3	1(3)	3(9)
Intersection Turns	2	0(0)	1(2)
V/C Ratio Range	1	1(1)	3(3)
<u>B. Road Improvement Costs</u>			
Road Construction Cost	2	3(6)	0(0)
Total Comparative Value		10	14
Transportation Rank [*]		1st	2nd

NOTES: * Rationale for Transportation Ranking: Option 1 has superior transportation safety qualities, although cost is higher.

+ Preferred route as identified through comparative analysis involving all site selection consultants.

TABLE 4.17
OWMC PHASE 4A - TRANSPORTATION
TRANSPORTATION RANKING OF TRANSFER ROUTES BETWEEN PI-1N AND LF-4M

<u>Factor/Indicators</u>	<u>Indicator Weight</u>	<u>Option Scale Value (Weight x Scale Value)</u>	
		<u>Option 1</u>	<u>Option 2⁺</u>
<u>A. Transport Safety</u>			
Accidents/million vehicles	3	3(9)	1(3)
Intersection Turns	2	1(2)	1(2)
<u>B. Road Improvement Costs</u>			
Road Construction Cost	2	1(2)	3(6)
Total Comparative Value		14	12
Transportation Rank [*]		2nd	1st

NOTES: * Rationale for Transportation Ranking: Option 2 has superior transport safety qualities and has only slightly higher costs.

+ Preferred route identified through comparative analysis involving all site selection consultants.

in Chapter 8. In each of these figures, the preferred local and regional access route and inter-site transfer route has been highlighted.

6.1 PREFERRED ACCESS ROAD DATA APPLIED TO DETAIL COMPARATIVE EVALUATION

The accident indicator for each of the preferred access route options was carried into the detailed comparative evaluation. These accident indicator data were used to determine the number of OWMC generated trucks involved in accidents, and to estimate the number of motor vehicle accident related spills which might occur.

The road improvement cost data presented in this chapter were refined before being applied to the detailed comparative analysis. These refinements occurred as more information became available regarding the number and type of vehicles being generated at the site. The improvement costs also included the construction of a site entrance and the cost of the additional land required to accommodate road improvements.

6.1.1 Significance of road land acquisition costs to overall road construction costs

During the comparison of access road options, the land area requirement for improvement was used as a indicator of the cost factor. This was assumed to be an adequate indicator as an input to the cost factor at this stage of site selection, in that the land cost component was judged to be a minor part of the overall construction cost of road improvements. With selection of the preferred access route it was recognized that land acquisition cost would be required to complete the cost inputs to the comparison of candidate siting options.

The land use consultant (Leon Kentridge Associates Ltd.) was instructed to engage the services of land appraisers to conduct a preliminary appraisal of the land acquisition requirements associated with the preferred road option at sites. The firm, Graydon Rogers Appraisals Limited was retained and conducted these appraisals. The results of their study are contained in the Leon Kentridge Associates 1985 report Site Selection Process Phase 4A: Selection of a Preferred Site(s) - Land Use. These provided the land cost estimate associated with the preferred access routes.

Table 4.19 provides a summary of the final construction costs, off-site land costs and the total cost for the selected preferred access route. These are the cost values applied by the engineering consultant in the comparison of siting options, Monenco Ltd., Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Engineering, 1985.

The cost information contained on Table 4.19 provides an opportunity to review the earlier assumption adopted, concerning the significance of land acquisition cost in the overall cost evaluation. It is noted that road land acquisition cost represents less than 3% of road construction cost. This confirms the approach used earlier where a land area surrogate value was used and assigned a low level of importance in the comparison of access road options.

TABLE 4.19
OWMC PHASE 4A - TRANSPORTATION
FINAL COSTS FOR ROAD IMPROVEMENTS APPLIED TO THE
DETAILED COMPARATIVE ANALYSIS OF SITES

<u>Site</u>	<u>Road Construction Cost</u>	<u>Road¹ Land Costs</u>	<u>Total Cost²</u>
LF-3C	\$384,000	\$ 4,100	\$388,100
LF-9C	\$106,000	Nil	\$106,000
LF-1E	\$594,000	\$ 1,200	\$595,200
PI-27E/LF-1E	\$700,000	\$ 1,200	\$701,200
PI-1N/LF-4N	\$593,000	\$11,300	\$604,300
PI-13N/LF-4N	\$479,000	\$11,300	\$490,300
PI-1N/LF-2N	\$401,000	\$ 9,600	\$410,600
PI-13N/LF-2N	\$463,000	\$ 9,600	\$469,600

-
- NOTE: 1. These costs are based on preliminary appraisals undertaken by Graydon Rogers Appraisals Ltd. and contained in the Leon Kentridge Associates 1985 report Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Land Use.
2. Cost details are included in Appendix H of the Transportation Technical Appendices.

CHAPTER 5

RAIL ACCESS OPTIONS

1. INTRODUCTION

Rail service to a candidate site(s), where such service is viable, is not viewed as a requirement but rather as an opportunity. Rail service is considered useful for the possible haulage of process additives and reagents which could be received in large bulk shipments at the OWMC operating plant. The rail mode has not been identified as a feasible means of transporting special waste to a centralized waste treatment facility (see Chapter 2).

The selection of a preferred rail access option involved two steps: constraint mapping, and comparative evaluation of access options. The inputs of all the consultants on the site selection team were considered in both steps of the process. Constraint mapping identified a number of viable rail access options which would connect the site to a national rail line. The comparative evaluation step analyzed these options in order to select the most preferable one.

The selection of a preferred rail access route to sites LF-1E and PI-1N was also affected by the refinement of the boundaries at each of these candidate sites. Boundary refinement was carried out in parallel to the detailed comparative examination of rail access options.

During the constraint mapping stage, transportation inputs were used to define rail access corridor limits within which a rail line could be located to meet both functional and rail line safety criteria. The transportation consultant also provided data regarding the zone of impact due to noise, and potential rail mishaps. The constraints posed by the other consultants within the feasible corridors and impact zones were used to select a number of access options. No rail options were identified through the constraint mapping analysis for LF-2N and PI-13N. A number of major constraints were associated with the provision of rail service to LF-2N and PI-13N. It was, therefore, assumed that rail service was not considered as an opportunity at these two sites. Further details are provided in the M.M. Dillon 1985 report Site Selection Process Phase 4A: Selection of a Preferred Site(s) - Site Selection.

A number of transportation factors were applied to the comparative evaluation of the rail access options. These factors included the following:

- ° number and type of roads crossed,
- ° provision of adequate sight and stopping distance between an intersection and a level rail crossing,
- ° amount of off-site land acquisition required, and
- ° cost of constructing rail infrastructure from main line to the site operating plant.

Information for compiling these factors was obtained from OWMC site plans and discussions with the various railway and roadway authorities.

This chapter details the process of applying the transportation factors to the rail access route options at each site. The framework and assumptions are discussed, the factors and

indicators are developed and aggregated, the data collection and analysis is outlined, and conclusions and recommendations are made regarding the rail access options.

2. FRAMEWORK AND ASSUMPTIONS

2.1 FRAMEWORK OF ANALYSIS

The provision of a railway spur line connection between the candidate site and a national rail line provides the site with the opportunity to haul process (i.e. non-waste) materials in large bulk shipments thereby reducing road haulage and possibly to provide savings in transport costs. In examining the rail opportunities to the various candidate sites, no attempt has been made to quantify the benefits or hazards which may be derived in terms of transportation risks or costs if one transport mode is chosen as opposed to another. In addition, the haulage of special waste material by rail has not been considered. This is simply an examination to discover what spur line routing, if any, is the most feasible should rail service be considered.

Figure 5.1 illustrates the steps involved with the transportation analysis of the rail access options.

2.2 GENERAL ASSUMPTIONS

Since this was to be a preliminary examination of rail access, assumptions have been made in a variety of areas as described in the following subsections.

2.2.1 Risk assessment

The decision not to undertake an accident risk assessment on either the proposed spur line or along the national rail line was based on the following considerations:

- ° Rail services on the access line and spur line would be relatively light averaging 34 rail car movements per week operating at maximum design capacity,
- ° Rail operational speeds along the spur line should be below 30 km per hour, therefore the severity in the event of an accident should be minimal,
- ° Recent studies, as noted in the Transport Canada report Transport Dangerous Goods, Dangerous Occurrences Reports 1981-1983 (August, 1984), and in the Transport Research Forum report Estimating the Risks of Transporting Hazardous Materials by Rail in Canada and the United States, 1984, tend to indicate that rail-related accidents and spills involving dangerous goods are more infrequent than those involving road transport,
- ° Additives and reagent materials are considered to pose less of a hazard to human health, Envirocons Corporation, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Generic Risk Assessment, 1985.

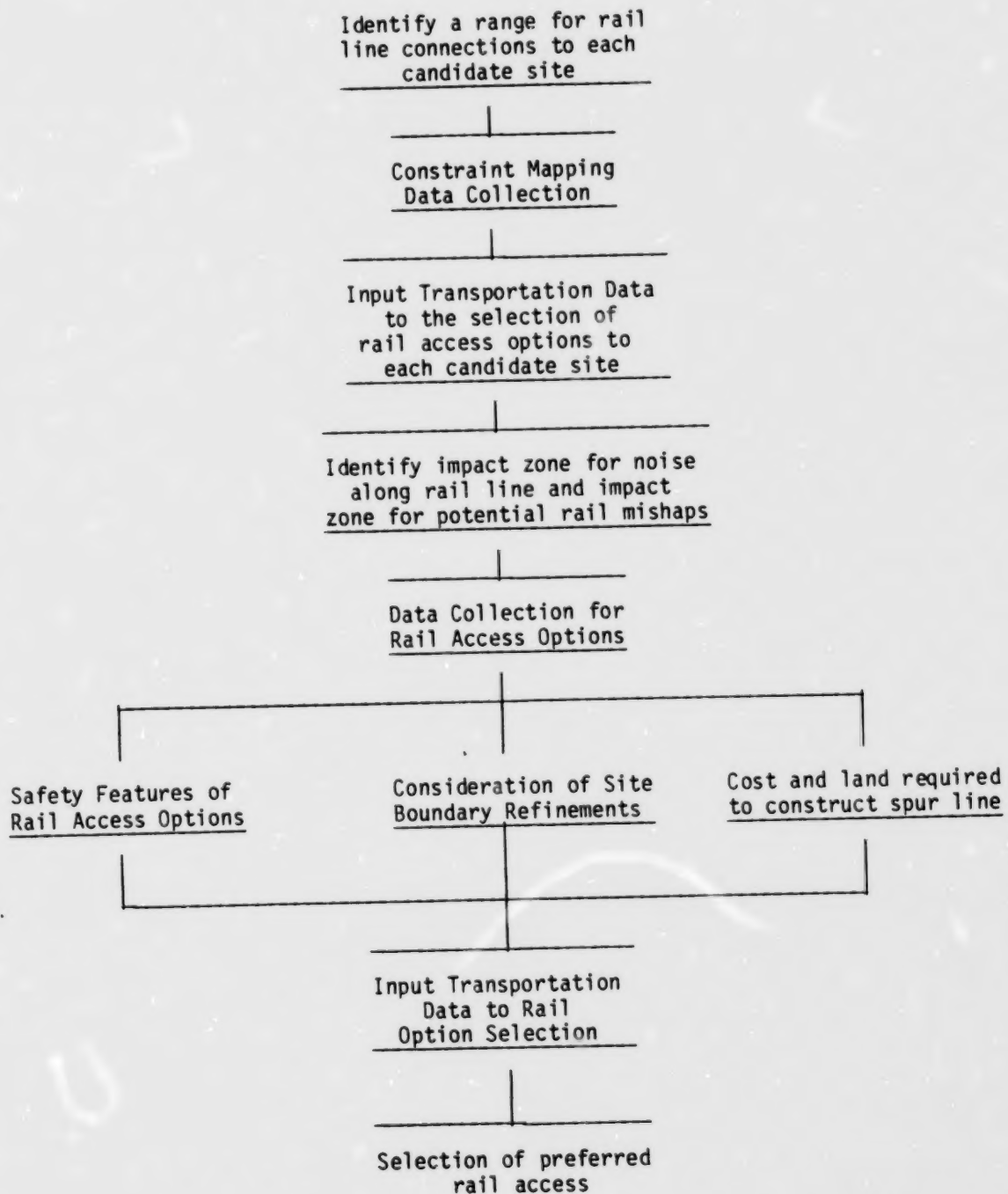
Further discussion of these considerations is provided in report Chapter 2 and Appendices G and L of the Transportation Technical Appendices.

2.2.2 Rail right-of-way requirement

The construction of a rail spur line between a national rail line and the physical chemical/incineration (PC/I) plant located within a candidate site, may require acquisition of a new right-of-way (ROW). This would be a basic requirement at any candidate site which does not flank the national rail line right-of-way. Consequently, it is necessary to assume a suitable right-of-way width (18.3 m) to accommodate a single track system including drainage ditches and fencing.

More detailed analysis of the rail option and right-of-way may be carried out during Phase 4B, however, the Phase 4A analysis was adequate for the selection of a preferred rail access option.

FIGURE 5.1
OWMC PHASE 4A TRANSPORTATION
RAIL ACCESS OPTION SELECTION PROCESS



2.2.3 Definition of rail noise corridor

To assess the social impacts of the proposed rail spur line connection from the national rail line into a candidate PC/I facility, it was necessary to define a rail noise corridor based on consideration of rail service noise generation. After an analysis of the estimated rail car movements between the mainline and the candidate site, a 170 m wide corridor along either side of the rail spur line was identified as the rail noise corridor. The derivation of this corridor width is discussed in Appendix L of the Transportation Technical Appendices.

A further impact zone was identified in relation to short-range events (explosives and fires) associated with rail line services. The corridor width of 250 m each side of the line was adopted as discussed in Section 3.3 of Chapter 2.

2.2.4 Rail spur line construction

In calculating the cost of rail line construction it was assumed that the terrain on which the spur line would be constructed was relatively flat with no heavy grading required. It was also assumed that at each road crossing there would be a level road crossing.

Based on the above design assumptions and current practices the following were assumed in estimating the cost for each rail access option:

- | | |
|---|-------------------|
| ° installation of track (including grading and drainage): | \$650/m |
| ° connection to mainline track: | \$130,000/option |
| ° road crossing safety equipment: | \$60,000/crossing |

The location of the termination point on site (at the plant location) was derived from preliminary plant location layouts supplied by Monenco Ltd. The connection to the mainline track includes two turnout connections or one turnout connection accompanied by a short length of by-pass track (as per site LF-9C, western option). The road crossing safety equipment includes flashers, bells and signals.

3. IDENTIFICATION OF FACTORS

The transportation factors developed for application to the selection of the preferred rail access to each site are identified in this section under risk, and cost factor groupings.

3.1 TRANSPORTATION RISK FACTOR GROUPING

Within the risk factor grouping the factors associated with transportation safety were applied. These factors include the following:

- ° number and type of roads crossed; and
- ° the provision of adequate sight and stopping distance between an intersection and level rail crossings.

The first factor includes only the roads crossed by the rail access option between the mainline rail line and the site boundary. There were three types of roadways considered by this indicator:

- ° local roads
- ° regional roads
- ° provincial highways

The impact of a rail crossing on each of these types of roads is different. The highest impact could be expected at a provincial highway crossing since these typically carry larger traffic volumes than local or regional roads. If the road crossed is also a site access road, the impact is even more important because it exposes the special waste hauling vehicles to greater potential for accident involvement. However, this probability is minimized since road transport to the site takes place during daylight hours and the rail spur line will likely be in operation only once or twice per week.

The potential risk at level rail/road crossings is also minimized by providing adequate level crossing protection (e.g. flashers, bells and signals) at each crossing. The cost of this protection measure is included as part of the cost factor.

In the case of site LF-9C, when the rail options to be compared crossed different road types, it is necessary to quantify the road's exposure. This is done by introducing a conflict index for each option which is the product of the road's AADT and the weekly number of trains expected to use the spur line. For comparative purposes each option's index value is divided by the lowest value to show the magnitude of difference.

The second factor ensures that motorists will have adequate sight and stopping distance when encountering the new level rail crossing. The Ontario Ministry of Transportation and Communications's Manual of Uniform Traffic Control Devices advises that rail crossing warning signs should be placed between 180 m to 240 m in advance of a crossing. Therefore, it is necessary to separate a roadway intersection and railway level crossing by this distance in order that motorists turning onto the roadway would receive adequate warning of the crossing.

3.2 TRANSPORTATION COST FACTOR GROUPING

In the transportation cost factor grouping, the following two factors were applied:

- ° total cost of rail line construction; and
- ° area of off-site land acquisition required for rail right-of-way

The cost of rail line construction includes the trackage, connection to mainline, grading and drainage, and the provision of road/rail crossing protection. This includes the length of track between the main line and the plant site but does not include any provisions for an on-site rail storage yard.

The area of off-site land acquisition is the amount of land required to provide an 18.3 m rail line right-of-way along the length of the rail spur line between the main line and the site boundary. Since the cost of this land acquisition is dependent on the current local land costs, the total cost requirement has not been included for each rail option. However the total cost of providing rail service along the preferred rail access routing has been documented in the section 5.1 of this chapter.

4. DATA COLLECTION AND ANALYSIS

4.1 DATA COLLECTION

The data collection and analysis process was used to prepare the transportation information necessary for input to the selection of a preferred rail access route. It also produced information which was applied by other consultants to formulate their inputs. The details of the data collection process are presented in Chapter 2.

4.2 ANALYSIS PROCEDURES

4.2.1 Constraint mapping

Constraint mapping was the first stage in the analysis. The transportation inputs at this stage identified a range of feasible rail access opportunities for each candidate site. This was based on both the geometric design requirements for rail operation and discussions with road and rail agencies.

The following basic requirements were used in laying out the preliminary geometrics of the rail lines:

- ° 50 m minimum curve radii
- ° a number 8 type railway turnout connection to the rail mainline

The identification of areas where rail access would be geometrically feasible helped to eliminate further investigations of areas around the site where rail access was not possible.

These two basic requirements were used in all cases, however, there were some variations in the method by which the rail line was connected to the national rail line. Where the angle of intersection with the main line was near 90°, it was normally possible to make a double connection to serve both directions of travel. However, where the mainline railway is heavily used the railway company may require the construction of a by-pass track to minimize conflicts on the mainline (this requirement was noted in relation to the CN Rail line in Milton). In instances where the spur line intersects the mainline at an acute angle the possibility for a two-way connection is limited unless a large penalty is accepted in property acquisition. To minimize this, a by-pass track was viewed to be the more appropriate solution and was applied in relation to candidate site LF-9C for spur line connections to the east of the site.

Discussions with road and rail agencies did not identify any major problem associated with providing a spur line to the mainline, at this time. However, when more details are available, further discussions will be held with the agencies.

Regarding level road crossings, the road agencies indicated that the crossings were generally acceptable, however adequate protection must be provided. The MTC indicated that the crossing of Highway 10 may require a grade separation in order to access site LF-2N.

4.2.2 Transportation comparative evaluation

The detailed comparative evaluation of the rail access options to each site involved factor inputs from all members of the site selection team. In addition to the transportation factors, M.M. Dillon - Transportation also identified two impact zones which were used by the other site selection consultants to determine the effects of a rail spur line on the surrounding environment, population and sensitive land uses. This subsection discusses the transportation analysis.

In most cases the road crossing factor used in the comparative evaluation was applied directly from the data source (i.e. 1:10 000 scale OWMC plans). However, in the case of site LF-9C, some additional analysis was required in order to differentiate between rail access options which crossed different types of roadways. In order to facilitate this comparison it was necessary to introduce the "road/rail conflict index" as part of this factor.

Rail access to site LF-9C can be provided from either the north or from the east. From the north, the railway spur line

must cross a local road and provincial Highway 20; the eastern routes cross three local roadways. In order to identify the importance of the impacts that a rail crossing may have on a provincial highway as opposed to local roads, the average annual daily traffic (AADT) of each roadway the rail line crossed was multiplied by the weekly railcar traffic expected along the spur line. This produced the rail/road conflict index for each rail access option. In comparing rail access options to LF-9C it was useful to express the conflict index of an access route in terms of the lowest index value of all options.

The "separation of an intersection and a level railway crossing" factor was based upon the Ontario Ministry of Transportation and Communications guidelines for providing adequate advance warning signing along a roadway that crosses a rail line. A desirable distance of 240 m is required for warning in advance of a rail line crossing. The minimum acceptable separation is 180 m - this separation is viewed to be acceptable only in the case of low volume local roads, i.e. excludes provincial and regional arterial roadways.

The cost of rail construction was based on the unit cost estimates presented in Section 2.2.4 and the configuration of the rail line option.

4.2.3 Identification of noise impact zone

A noise impact zone of 170 m on either side of a rail spur line option was identified by S.S. Wilson Associates in the noise analysis documented in Appendix L of the Transportation Technical Appendices. This zone was developed based upon the estimated frequency of travel along the rail spur line, and the number of rail cars required to carry the additives and reagents to the physical chemical treatment plant.

This impact zone was utilized by Leon Kentridge Associates and the Institute of Environmental Research to evaluate the rail spur line options in terms of the different impacts of the rail line on the sensitive receptors within the noise impact zone.

4.2.4 Identification of risk zone

A risk zone of 250 m on either side of a rail spur line option was identified by M.M. Dillon - Transportation. This zone size was based upon the findings in a report prepared for the Canadian Transport Commission Railway Transport Committee by Ian Burton and Keith Post in May 1983 entitled The Transport of Dangerous Commodities by Rail in the Toronto Census Metropolitan Area: A Preliminary Assessment of Risk. This report defines an "inner risk zone" of 250 m on either side of railway line as "...a reasonable limit beyond which the impact of short-ranged events (explosions and fires) are less likely to have major impact".

The risk zone was utilized by the other consultants on the site selection team to compare the rail access options in terms of the possible risk to sensitive receptors within the 500 m risk zone.

4.3 RESULTS OF ANALYSIS

This section presents the results of the transportation analysis for selecting a preferred rail access route. The results of both the constraint mapping and comparative evaluation stages are discussed.

4.3.1 Constraint mapping

The results at this stage of the rail access option selection were used with the findings of the other members of the site

selection team to reach conclusions regarding the desirability of providing rail service to the eight candidate sites. In some cases, rail access options were identified.

In the case of rail service to sites LF-2N and PI-13N a number of major constraints were noted from a transportation viewpoint. These constraints along with others lead to the recommendation that rail access was not considered as an opportunity at these two sites as documented in the report, M.M. Dillon Ltd., Site Selection Process, Phase 4A: Selection of a Preferred Sites(s) - Site Selection, 1985.

The following outlines the rail access opportunities at these two candidate sites. The transportation data is summarized in Table 5.1.

a) LF-2N. The most feasible rail connection is the CPR line located 4.5 km west of the site. The spur line would connect to the mainline just north of Highway 401 and would cross three roads: Third Line West (Credit View Road), Second Line West (Chinguacousy Road), and McLaughlin Road; two streams: Credit River and Fletchers Creek and one provincial highway: Highway 10.

Preliminary investigations have revealed that the Credit River crossing will require an 800 m structure which would also cross Third Line West. The Fletcher Creek crossing would require a 200 m structure.

The estimated construction cost (\$12.68 million) includes level rail crossings for Second Line West, McLaughlin Road and Highway 10. However, preliminary discussions with MTC reveal that a grade separation at Highway 10 may be warranted. If a structure is required, it will have a large impact on rail construction costs, and may also impact the on-site facilities design and layout.

b) PI-13N. The PI-13N site is best served from the double track CPR line located 5 km north of the site at an estimated construction cost of \$4.28 million. An alternative connection would be the CNR line west of the site; however, this routing would be longer, cross more roadways and streams, and would not provide double trackage as does the CPR line.

One constraint to the rail routing is the Parkway Belt West which is located between Fourth Line and Fifth Line Roads. This belt has been identified as a possible routing for an arterial link between Highway 403 and Highway 401. The presence of a rail line in this corridor parallel to the roadway would create problems for future road development. The rail line would pose a constraint to the road's alignment, and would necessitate railway crossings on each east-west connecting road.

This leaves two possible corridors for rail access: between Fifth Line and Sixth Line Roads, or between Sixth Line and Trafalgar Roads. The Fifth/Sixth Line Road corridors is favoured since it provides a more direct access, with fewer road crossings, and avoids any conflicts with Sixteen Mile Creek. The range of possible alignments must also maintain a 180 m to 240 m spacing between a rail crossing and an intersection.

TABLE 5.1
OWMC PHASE 4A - TRANSPORTATION
SUMMARY OF TRANSPORTATION FACTOR VALUES FOR RAIL ACCESS TO
PI-13N AND LF-2N

Factors	LF-2N	PI-13N
- Road Crossings	- Three local road crossings - One provincial highway crossing	- Two regional road crossings
- Amount of Land required	- 8.60 ha (4700 m to mainline)	- 9.5 ha (5200 m to mainline rail)
- Estimated Construction cost	- \$12.68 million	- \$4.28 million

At the conclusion of the constraint mapping step and the screening of rail access corridors at each candidate site, a number of viable rail access options were identified at six sites: LF-4N, PI-1N, LF-3C, LF-9C, LF-1E and PI-27E. The options identified at each of these are recorded in Figures 5.2 through 5.7. These are the options compared in the next step of the process.

4.3.2 Comparative evaluation of rail access options

The rail access options identified in the constraint mapping stage were compared during the comparative evaluation stage. During this stage the transportation factors were applied and the rail access options were ranked with respect to transportation considerations.

Concurrent with the comparative evaluation of the rail access options, the site boundary refinements took place. As a result of these boundary refinements, rail option 4 was deleted from the comparison at site LF-1E because it no longer provided access to the plant facilities on site.

The transportation factor dealing with sight distance between an intersection and a railway crossing was considered a mandatory requirement for all rail access options. Therefore any rail option which did not meet this criterion was eliminated from the detailed comparative evaluation. This included the following options at each of the candidate sites:

<u>Site</u>	<u>Options Eliminated Due to Inadequate Sight Distance Between Rail Crossing and Intersection</u>
LF-3C	3
LF-9C	2, 3
LF-4N	4
LF-1E	2

The remaining options were examined in the transportation detailed comparative evaluation of rail access options. The data for each of these options are shown in Table 5.2 to 5.7.

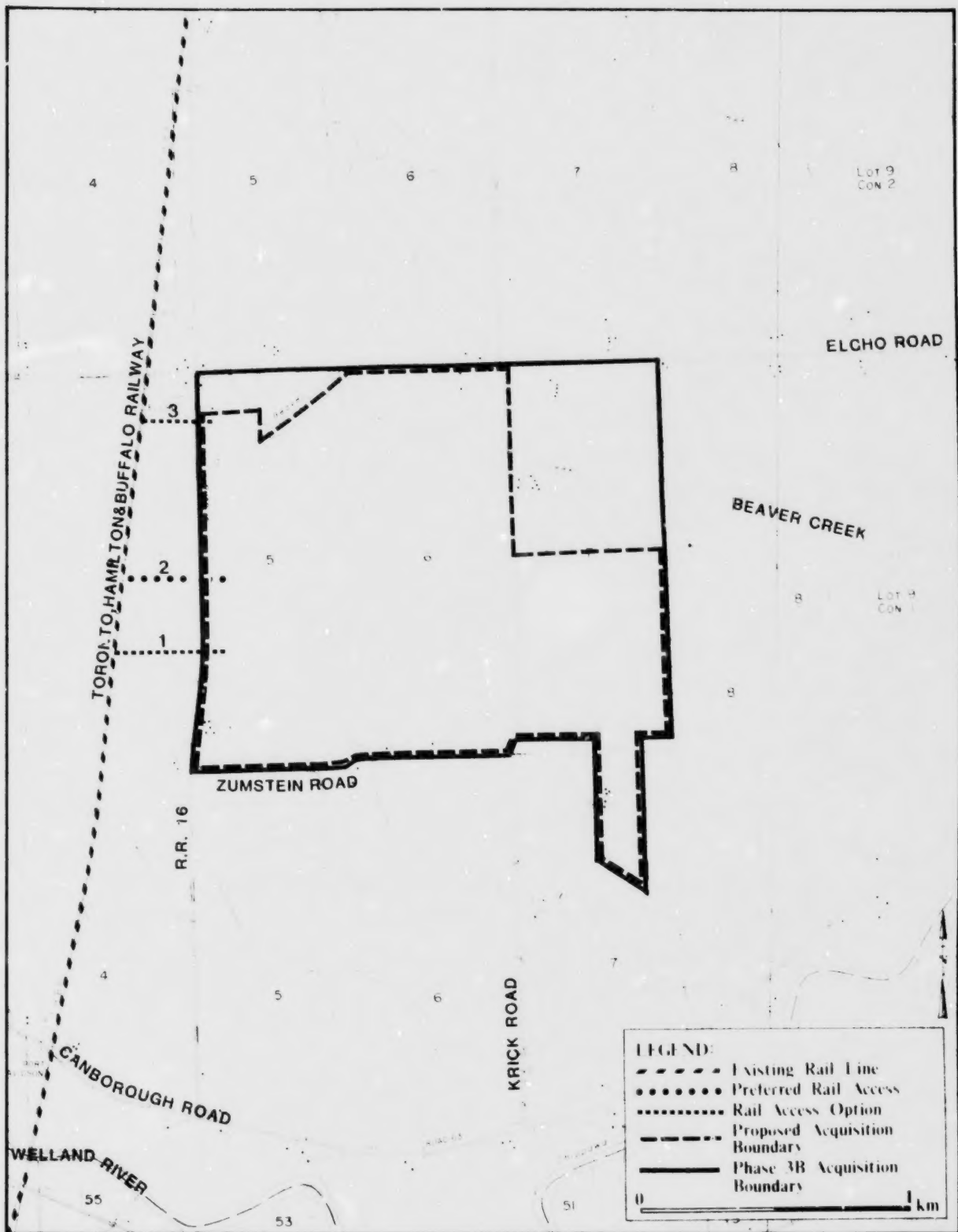
5. RANKING AND AGGREGATION OF FACTORS AND INDICATORS

The comparative evaluation of rail access options involved the ranking and aggregation of the factors employed in the selection process. This comparative evaluation applied only to those sites where more than one rail access route was identified (LF-3C, LF-9C, LF-4N, LF-1E, PI-1N). Therefore site PI-27E was not included in this portion of the analysis since only one rail access route was identified. At the conclusion of the constraint mapping stage it was stated that there are no rail access routes to sites PI-13N and LF-2N which are desirable.

5.1 FACTOR SCREENING

The data resulting from the analysis were investigated to identify factors which were not useful in determining differences between the rail access options and should therefore be screened from the process. Table 5.8 shows the factors which were screened from the process and the rationale for their screening.

In all cases the factor "intersection/railway separation distance" has been screened from the analysis. The rationale for this screening is that all options which did not provide at least a 180 m separation between a railway crossing and an intersection were removed from the transportation comparative analysis.

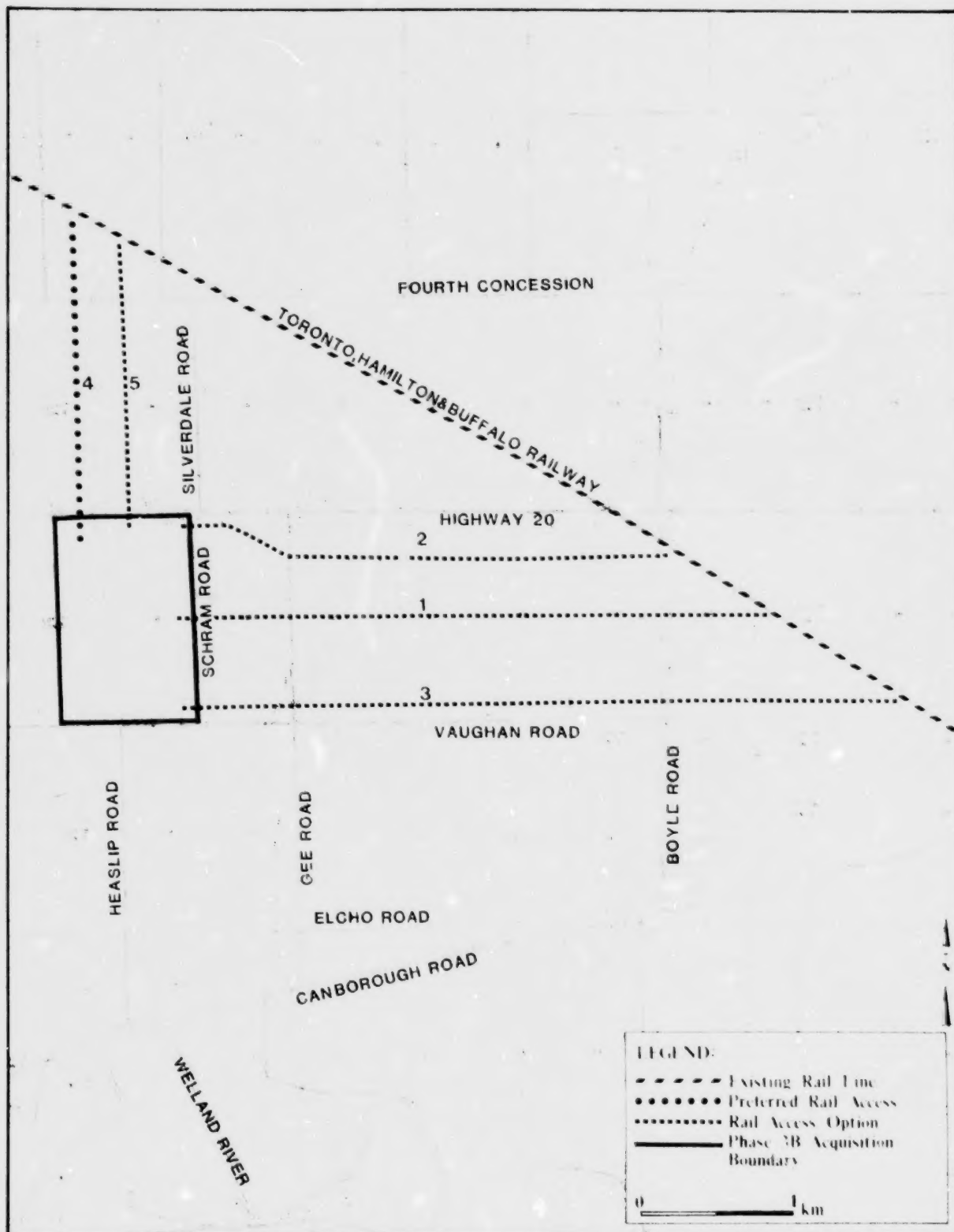


OWMC SITE SELECTION
- TRANSPORTATION

DILLON

**LF-3C
RAIL ACCESS**

FIGURE 5.2

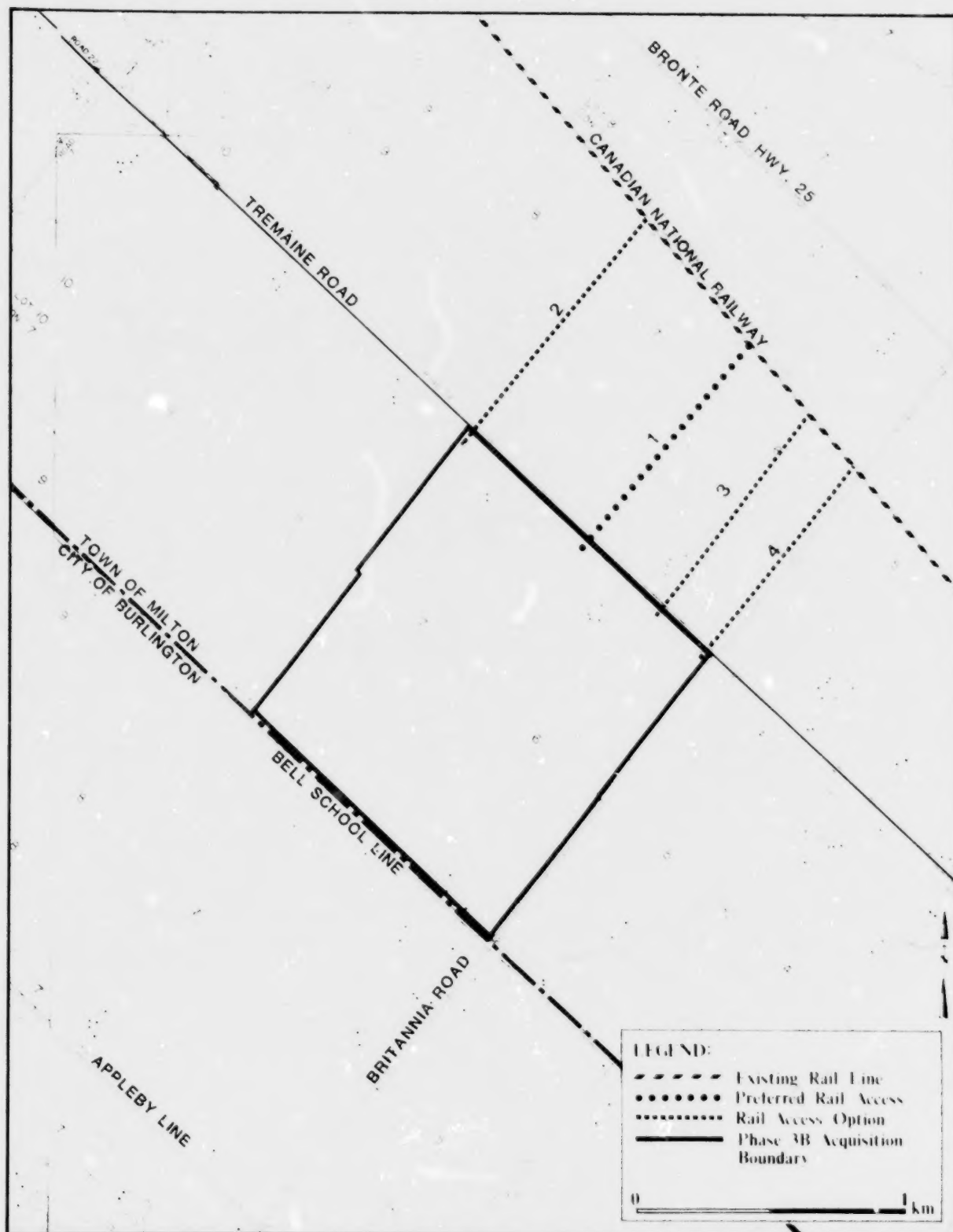


OWMC SITE SELECTION
- TRANSPORTATION

DILLON

LF-9C
RAIL ACCESS

FIGURE 5.3

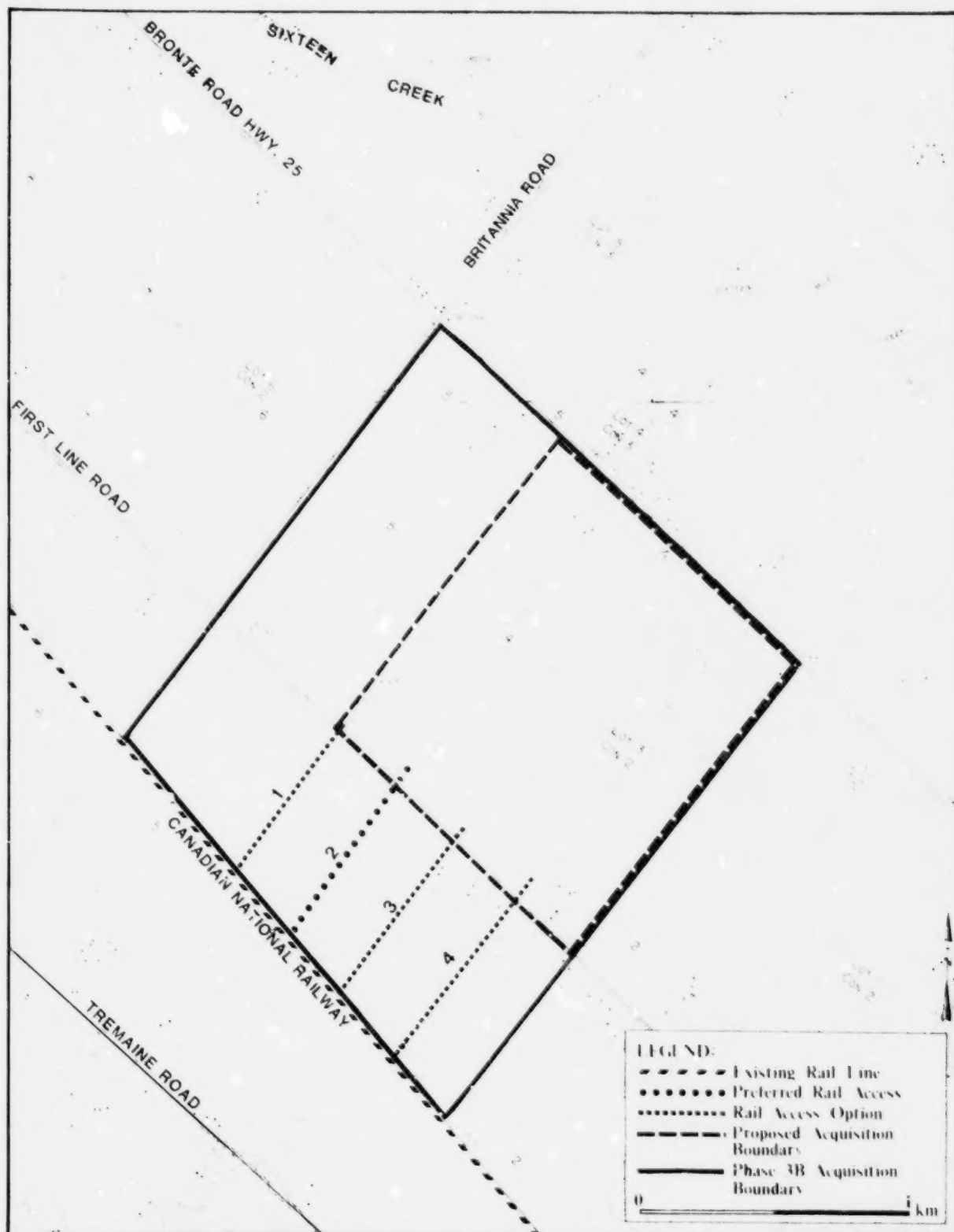


OWMC SITE SELECTION
- TRANSPORTATION

DILLON

LF-4N
RAIL ACCESS

FIGURE 5.4

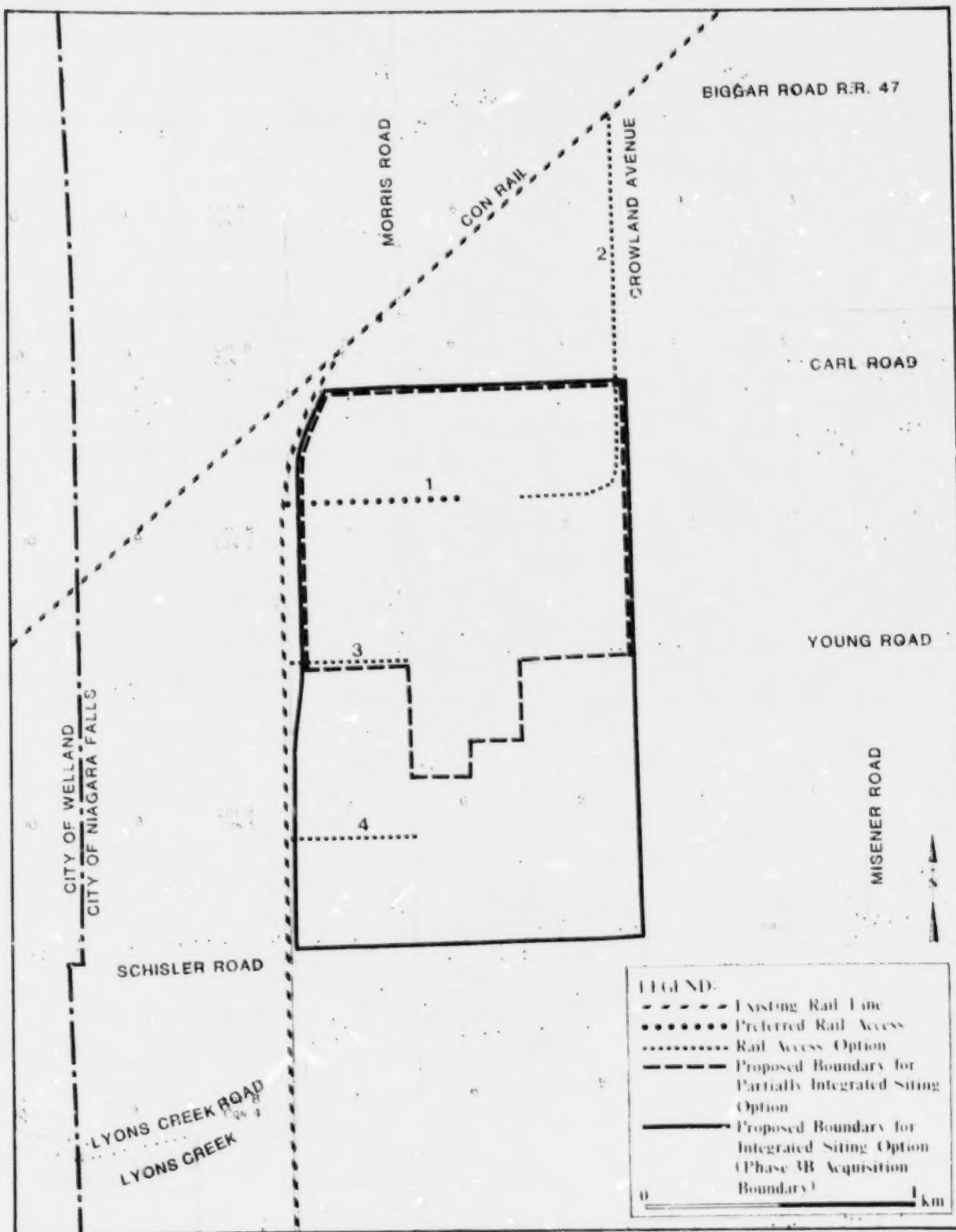


OWMC SITE SELECTION
- TRANSPORTATION

DILLON

PI-1N
RAIL ACCESS

FIGURE 5.5

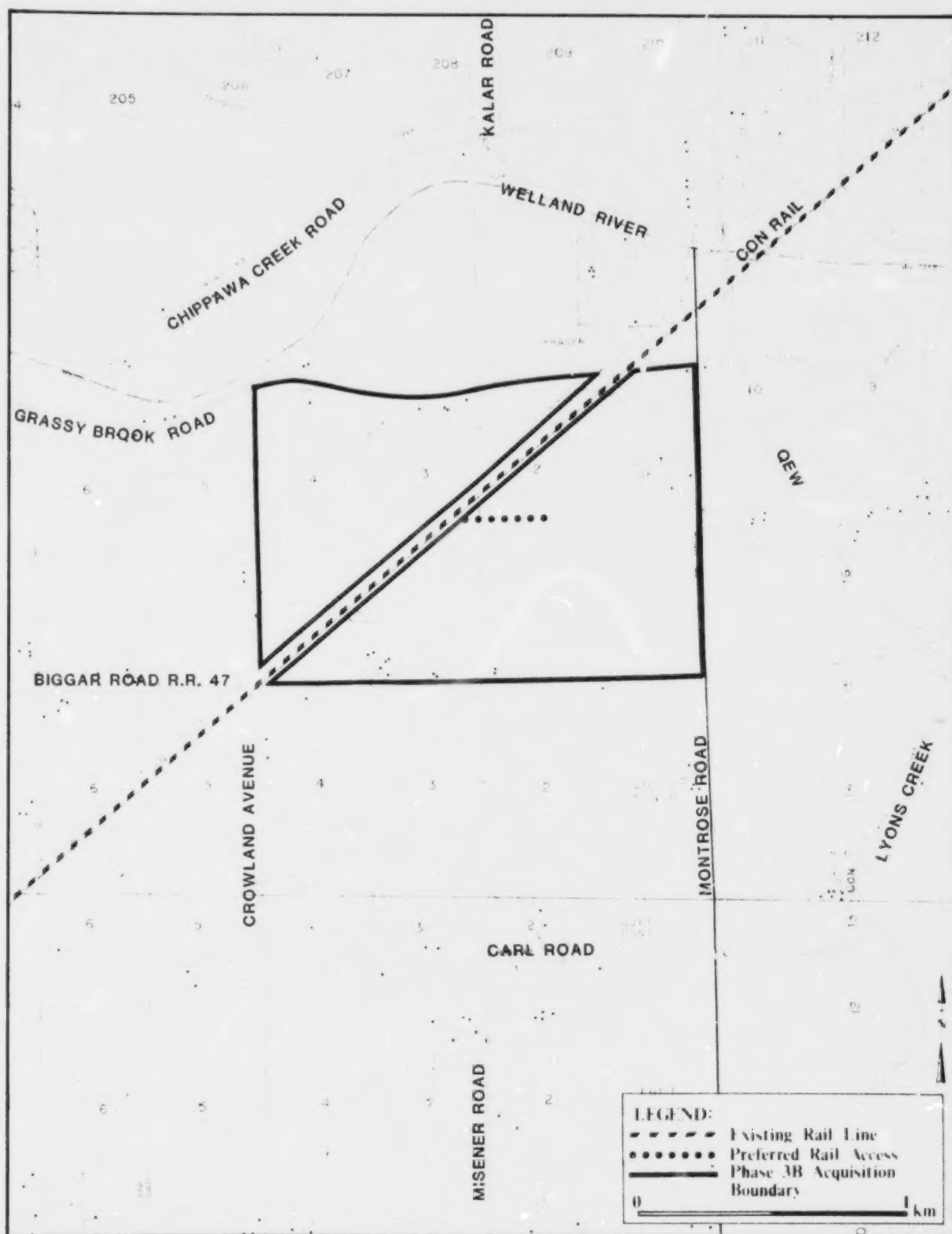


OWMC SITE SELECTION
- TRANSPORTATION

DILLON

**LF-1E
RAIL ACCESS**

FIGURE 5.6



OWMC SITE SELECTION
- TRANSPORTATION

DILLON

PI-27E
RAIL ACCESS

FIGURE 5.7

TABLE 5.2
OWMC PHASE 4A - TRANSPORTATION
RAIL ACCESS OPTIONS - COMPARATIVE EVALUATION DATA
CANDIDATE SITE LF-3C

<u>Factors</u>	<u>Rail Options</u>		
	<u>1</u>	<u>2</u>	<u>3¹</u>
° Intersection/Railway Separation Distance	>240 m	>240 m	<180 m
° Road Crossings			
. local	0	0	
. regional	1	1	
. highway	0	0	
. access route	0	0	
. conflict index			
° Off-site land acquisition required (ha)	0.6	0.55	
° Cost of rail infrastructure from mainline to plant in millions of dollars (spur line length)	0.919 (1120 m)	0.893 (1080 m)	

NOTES: 1. This option eliminated due to sight and stopping distance requirements.

TABLE 5.3
OWMC PHASE 4A - TRANSPORTATION
RAIL ACCESS OPTIONS - COMPARATIVE EVALUATION DATA
CANDIDATE SITE LF-9C

Factors	Rail Options				
	1	2 ¹	3 ¹	4	5
° Intersection/Railway Separation Distance	>240 m	<180 m	<180 m	180-240 m	>240 m
° Road Crossings					
. local	3			1	1
. regional	0			0	0
. highway	0			1	1
. access route	0			0	0
. conflict index	1.00			5.57	5.57
° Off-site land acquisition required (ha)	5.78			3.70	3.52
° Cost of rail infrastructure from mainline to plant in millions of dollars (spurline length)	3.002 (4140 m)			2.129 (2890 m)	2.103 (2850 m)

NOTES: 1. These options eliminated due to sight and stopping distance requirements.

TABLE 5.4
OWMC PHASE 4A - TRANSPORTATION
RAIL ACCESS OPTIONS - COMPARATIVE EVALUATION DATA
CANDIDATE SITE LF-4N

<u>Factors</u>	<u>Rail Options</u>			
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4¹</u>
° Intersection/Railway Separation Distance	>240 m	>240 m	>240 m	<180m
° Road Crossings				
. local	0	0	0	
. regional	1	1	1	
. highway	0	0	0	
. access route	0	0	0	
. conflict index	N/A	N/A	N/A	
° Off-site land acquisition required (ha)	0.81	0.85	0.77	
° Cost of rail infrastructure from mainline to plant in millions of dollars (spurline length)	1.348 ² (1780 m)	1.842 ² (2540 m)	1.283 ² (1680 m)	

NOTES: 1. This option eliminated due to sight and stopping distance requirements.

2. An additional 1 km of by-pass track may be required for each option (see Section 4.2.1).

TABLE 5.5
OWMC PHASE 4A - TRANSPORTATION
RAIL ACCESS OPTIONS - COMPARATIVE EVALUATION DATA
CANDIDATE SITE PI-1N

Factors	Rail Options			
	1	2	3	4
° Intersection/Railway Separation Distance	>240 m	>240 m	>240 m	>240 m
° Road Crossings				
. local	1	1	1	1
. regional	0	0	0	0
. highway	0	0	0	0
. access route	1	0	0	0
. conflict index	N/A	N/A	N/A	N/A
° Off-site land acquisition required (ha)	1.15	1.21	1.28	1.35
° Cost of rail infrastructure from mainline to plant in millions of dollars (spurline length)	1.074 ¹ (1780 m)	0.944 ¹ (1250 m)	1.166 ¹ (1500 m)	1.381 ¹ (1830 m)

NOTES: 1. An additional 1 km of by-pass track may be required for each option (see Section 4.2.1).

TABLE 5.6
OWMC PHASE 4A - TRANSPORTATION
RAIL ACCESS OPTIONS - COMPARATIVE EVALUATION DATA
CANDIDATE SITE LF-1E

<u>Factors</u>	<u>Rail Options</u>			
	<u>1</u>	<u>2²</u>	<u>3</u>	<u>4¹</u>
° Intersection/Railway Separation Distance	N/A	<180 m	N/A	
° Road Crossings				
. local	0		0	
. regional	0		0	
. highway	0		0	
. access route	0		0	
. conflict index	N/A		N/A	
° Off-site land acquisition required (ha)	0.18		0.18	
° Cost of rail infra-structure from mainline to plant in millions of dollars (spurline length)	0.677 (840 m)		0.697 (870 m)	

NOTES: 1. This option eliminated because it no longer provided access to the plant facilities, following boundary refinements.

2. This option eliminated because it violated sight and stopping distance requirements.

TABLE 5.7
OWMC PHASE 4A - TRANSPORTATION
RAIL ACCESS OPTIONS - COMPARATIVE EVALUATION DATA
CANDIDATE SITE PI-27E

<u>Factors</u>	<u>Rail Option</u>
	<u>1</u>
° Intersection/Railway Separation Distance	N/A
° Road Crossings	
. local	0
. regional	0
. highway	0
. access route	0
. conflict index	N/A
° Off-site land acquisition required (ha)	N/A
° Cost of rail infrastructure from mainline to plant in millions of dollars (spurline length)	0.390 (400 m)

TABLE 5.8
OWMC PHASE 4A - TRANSPORTATION
SCREENING OF FACTORS USED IN
DETAILED COMPARATIVE EVALUATION OF RAIL ACCESS OPTIONS

<u>Site</u>	<u>Factors Screened</u>	<u>Rationale</u>
LF-3C	- Intersection/Railway Separation Distance	- All options violating this constraint were removed from the transportation analysis
	- Number of Road Crossings	- All options cross the same roadway
LF-9C	- Intersection/Railway Separation Distance	- All options violating this constraint were removed from the transportation analysis
LF-4N	- Intersection/Railway Separation Distance	- All options violating this constraint were removed from the transportation analysis
	- Number of Road Crossings	- All options cross the same roadway
PI-1N	- Intersection/Railway Separation Distance	- No occurrence in any option
LF-1E	- Intersection/Railway Separation Distance	- All options violating this constraint were removed from the analysis
	- Off-site Land Acquisition	- All options have same amount of off-site land requirements
	- Number of Road Crossings	- No occurrence for any option

At three sites (LF-1E, LF-3C and LF-4N) the factor "number of road crossings" was removed because all options at each site crossed the same roadway or no roadways to access the site, and therefore no distinction could be made between the options on the basis of that factor.

At site LF-1E all options require the same amount of off-site land to accommodate the rail right-of-way therefore this factor was screened.

5.2 FACTOR LEVEL OF IMPORTANCE

Each factor remaining after screening was ranked as to its individual importance to the selection of a preferred rail access. These levels of importance applied to each option comparison made for each site.

<u>Level of Importance</u>	<u>Factor</u>
MEDIUM	Number of level rail crossings introduced
MEDIUM	Cost of rail infrastructure construction
LOW	Off-site land acquisition required

The road crossing factor is rated MEDIUM. This transport safety concern is mitigatable and the cost of rail construction already includes the provision of level rail crossing protection devices in its calculations.

The rail spur line construction costs are given a MEDIUM level of importance. These costs reflect the distance between the site and the main rail line, and includes the cost for mitigating conflicts with road users at new level railway crossings.

The amount of off-site land acquisition is given a LOW level of importance. This component of cost will not be as high as the cost of the railway infrastructure which is given a medium level of importance.

5.3 SCALING OF FACTORS

The scaling process transforms the physical units of the factor value into units of desirability for input to the comparative process. For the transportation analysis, three levels of desirability were utilized in the scaling process: low, medium and high. To determine the scaled level that aligns with each option's factor value, the range of factor values was divided into three equal parts to represent the three scaling levels. The scaling levels were each assigned a value of 1, 2 and 3 corresponding with low, medium, and high, respectively.

In cases where only two options were to be compared only two scaling levels were utilized: high and low. The factor value which was significantly higher would be given the higher scaling value of 3; the lower value was given the value 1. This process was applied for the comparison at sites LF-3C, PI-1N and LF-1E where the other access options were removed from the analysis.

In instances where the factor value was zero, the scaled value assigned was also zero.

The scaled values for the factors used to compare the rail options at each site are shown in Tables 5.9 to 5.13.

5.4 RANKING OF RAIL ACCESS OPTIONS TO EACH SITE

To provide a consistent basis for ranking of options, numeric values are assigned to factor importance ranking. Thus, the following weights were assigned and used in the calculations:

TABLE 5.9
OWMC PHASE 4A - TRANSPORTATION
SCALING OF FACTOR VALUES FOR RAIL ACCESS OPTIONS AT SITE LF-3C

<u>Factor</u>	<u>Scaled Value for Each Option¹</u>		<u>Rationale for Scaling</u>
	<u>Option 1</u>	<u>Option 2</u>	
° Cost of Rail Infra-Structure Construction	1	2	° 8% difference between options
° Off-site Land Acquisition	3	1	° 3% difference between options

NOTE: 1. Scaling rule where only two options are involved is discussed in Section 5.3.

TABLE 5.10
OWMC PHASE 4A - TRANSPORTATION
SCALING OF FACTOR VALUES FOR RAIL ACCESS OPTIONS AT SITE LF-9C

<u>Factor</u>	<u>Scaled Value for Each Option</u>			<u>Rationale for Scaling</u>
	<u>Option 1</u>	<u>Option 4</u>	<u>Option 5</u>	
° Number of Road Crossings	1	3	3	° Conflict Index Value 5.5 times larger for options 4 and 5
° Cost of Rail Infrastructure Construction	3	1	1	° Applied scaling rule #1 below
° Off-site Land Acquisition	3	1	1	° Applied scaling rule #2 below

Scaling Rules:

1. Cost of Rail Infra-structure Construction

<u>Cost (\$Mill)</u>	<u>Scaled Value</u>
2.103 to 2.403	1
2.404 to 2.702	2
2.703 to 3.002	3

2. Off-site Land Acquisition

<u>Land (ha)</u>	<u>Scaled Value</u>
3.52 to 4.27	1
4.28 to 5.03	2
5.04 to 5.78	3

TABLE 5.11
OWMC PHASE 4A - TRANSPORTATION
SCALING OF FACTOR VALUES FOR RAIL ACCESS OPTIONS AT SITE LF-4N

<u>Factor</u>	<u>Scaled Value for Each Option</u>			<u>Rationale for Scaling</u>
	<u>Option 1</u>	<u>Option 2</u>	<u>Option 3</u>	
° Cost of Rail Infra-structure Construction	2	3	1	° Applied scaling rule #1 below
° Off-site Land Acquisition	2	3	1	° Applied scaling rule #2 below

Scaling Rules:

1. Cost of Rail Infra-structure Construction

<u>Cost (\$Mill)</u>	<u>Scaled Value</u>
1.283 to 1.469	1
1.470 to 1.656	2
1.657 to 1.842	3

2. Off-site Land Acquisition

<u>Land (ha)</u>	<u>Scaled Value</u>
0.77 to 0.79	1
0.81 to 0.82	2
0.83 to 0.85	3

TABLE 5.12
OWMC PHASE 4A - TRANSPORTATION
SCALING OF FACTOR VALUES FOR RAIL ACCESS OPTIONS AT SITE PI-1N

<u>Factor</u>	<u>Scaled Value for Each Option</u>				<u>Rationale for Scaling</u>
	<u>Option 1</u>	<u>Option 2</u>	<u>Option 3</u>	<u>Option 4</u>	
° Number of Road Crossings	3	1	1	1	° Option 1 crosses a site access road
° Cost of Rail Infra-structure Construction	1	1	2	3	° Applied scaling rule #1 below
° Off-site Land Acquisition	1	1	2	3	° Applied scaling rule #2 below

Scaling Rules:

1. Cost of Rail Infra-structure Construction

<u>Cost (\$Mill)</u>	<u>Scaled Value</u>
0.944 to 1.090	1
1.091 to 1.235	2
1.236 to 1.381	3

2. Off-site Land Acquisition

<u>Land (ha)</u>	<u>Scaled Value</u>
1.15 to 1.22	1
1.23 to 1.28	2
1.29 to 1.35	3

TABLE 5.13
OWMC PHASE 4A - TRANSPORTATION
SCALING OF FACTOR VALUES FOR RAIL ACCESS OPTIONS AT SITE LF-1E

<u>Factor</u>	<u>Scaled Value for Each Option¹</u>		<u>Rationale for Scaling</u>
	<u>Option 1</u>	<u>Option 2</u>	
° Cost of Rail Infra-Structure Construction	1	3	° a 3% difference between options

NOTE: 1. Scaling rule where only two options are involved is discussed in Section 5.3.

Factor Rank
Importance

Weighted Value

Medium
Low

2
1

The factor weightings are multiplied by the scaled values assigned for each factor. The total of these products for each option are used as a basis for ranking the rail access options. A minimum value identifies the best rail option and the highest value identifies the worst option.

The transportation ranking of the rail access route options, as shown in Tables 5.14 to 5.18 reflect the ranking from a transportation perspective only. Rationale for these rankings are also discussed. These rankings, along with rankings produced by the other site selection consultants, were synthesized to select the preferred rail access option. The tables also indicate which option was selected by the site selection team.

5.5 PREFERRED RAIL OPTIONS

All consultants submitted their data inputs and the results of the ranking activity to the site selection group. The details of the synthesis process is described in the report, M.M. Dillon Limited, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection, 1985.

5.5.1 Rail land acquisition costs

During the comparison of rail options, the land area requirement to accommodate a rail service option was used as a factor. This was judged to be an adequate measure as an input to the cost factor at this stage of site selection, in that the land cost component was viewed to be a relatively minor part (about 1%) of overall construction cost of the rail service opportunity.

TABLE 5.14
OWMC PHASE 4A - TRANSPORTATION
TRANSPORTATION RANKING OF RAIL ACCESS OPTIONS
TO CANDIDATE SITE LF-3C

<u>Factor</u>	<u>Factor Weight</u>	<u>Option Scaled Value (Weight x Scale Value)</u>		
		<u>Option 1</u>	<u>Option 2⁺</u>	<u>Option 3</u>
° Cost of Rail Infrastructure construction	2	1(2)	3(6)	
° Off-site Land Acquisition	1	3(3)	1(1)	
Total Comparative Value		5	7	
Transportation Rank		1st	1st	Excluded ¹

Rationale for Transportation Ranking:

Both options are equal in term of transportation safety, and differences in costs are very small (less than 3% difference).

NOTES: 1. This option excluded due to violation of intersection/railway separation distance requirement.

+ Option preferred by site selection team.

TABLE 5.15
OWMC PHASE 4A - TRANSPORTATION
TRANSPORTATION RANKING OF RAIL ACCESS OPTIONS
TO CANDIDATE SITE LF-9C

Factor	Factor Weight	Option Scale Value (Weight x Scale Value)				
		Option 1	Option 2	Option 3	Option 4 ⁺	Option 5
° Number of Road Crossings (Conflict Index)	2	1(2)			3(6)	3(6)
° Cost of Rail Infrastructure Construction	2	3(6)			1(2)	1(2)
° Off-site Land Acquisition	1	3(3)			1(2)	1(2)
Total Comparative Value		11			10	10
Transportation Rank		1st	Excluded ¹	Excluded ¹	2nd	2nd

Rationale for Transportation Ranking:

Option 1 is favoured because the differences between the options in terms of safety (road crossings) is greater than differences in cost.

NOTES: 1. These options excluded due to violation of intersection/railway separation distance requirement.

+ Option preferred by site selection team.

TABLE 5.16
OWMC PHASE 4A - TRANSPORTATION
TRANSPORTATION RANKING OF RAIL ACCESS OPTIONS
TO CANDIDATE SITE LF-4N

<u>Factor</u>	<u>Factor Weight</u>	<u>Option Scale Value (Weight x Scale Value)</u>			
		<u>Option 1⁺</u>	<u>Option 2</u>	<u>Option 3</u>	<u>Option 4</u>
° Cost of Rail Infra-structure Construction	2	2(4)	3(6)	1(2)	
° Off-site Land Acquisition	1	2(2)	3(3)	1(1)	
Total Comparative Value		6	9	3	-
Transportation Rank		2nd	3rd	1st	Excluded ¹

Rationale for Transport Ranking:

Since Options 1, 2 and 3 are equivalent in terms of transportation safety, ranking is based on differences in costs. Option 3 cost is 5% less than Option 1, and 44% less than Option 2.

NOTES: 1. This option excluded due to a violation of intersection/railway separation distance requirement.

+ Option preferred by site selection team.

TABLE 5.17
OWMC PHASE 4A - TRANSPORTATION
TRANSPORTATION RANKING OF RAIL ACCESS OPTIONS
TO CANDIDATE SITE PI-1N

<u>Factor</u>	<u>Factor Weight</u>	<u>Option Scale Value (Weight x Scale Value)</u>			
		<u>Option 1</u>	<u>Option 2⁺</u>	<u>Option 3</u>	<u>Option 4</u>
° Number of Road Crossings	2	3(6)	1(2)	1(2)	1(2)
° Cost of Rail Infrastructure Construction	2	1(2)	1(2)	2(4)	3(6)
° Off-site Land Acquisition	1	1(1)	1(1)	2(2)	3(3)
Total Comparative Value		9	5	8	11
Transportation Rank		4th	1st	2nd	4th

Rationale for Transport Ranking:

Option 2 provides the best transportation qualities in terms of safety and costs. Option 1 crosses an access road, and Option 4 has highest costs, and similar safety value as 2 and 3.

NOTES: + Option preferred by site selection team.

TABLE 5.18
OWMC PHASE 4A - TRANSPORTATION
TRANSPORTATION RANKING OF RAIL ACCESS OPTIONS
TO CANDIDATE SITE LF-1E

<u>Factor</u>	<u>Factor Weight</u>	<u>Option Scale Value (Weight x Scale Value)</u>			
		<u>Option 1⁺</u>	<u>Option 2</u>	<u>Option 3</u>	<u>Option 4</u>
° Infrastructure Costs	2	1(2)		3(6)	
Total Comparative Value		2		6	
Transportation Rank		1st	Excluded ¹	1st	Excluded ²

Rationale for Transport Ranking:

Both options are equal in transport safety, and very little difference in costs.

NOTES: + Option preferred by site selection team.

1. Option 2 excluded due to violation of intersection/railway separation distance requirement.
2. Option 4 excluded following site boundary refinements.

However, with the selection of a preferred rail access, it was recognized that land acquisition cost would need to be quantified and used as a further cost input to the comparison of candidate siting options.

Consequently, the land use consultant (Leon Kentridge Associates Ltd.) was instructed to engage the services of land appraisers to conduct a preliminary appraisal of the land acquisition requirements associated with the preferred rail access at sites. The firm, Graydon Rogers Appraisals Limited was retained and conducted these appraisals. The results of their analysis are presented in the report prepared by Leon Kentridge Associates in 1985, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Land Use. These provided the land cost estimates associated with preferred rail access.

Table 5.19 provides a summary of construction costs, off-site land costs and the total cost for the selected preferred rail service opportunity. These are the cost values applied by the engineering consultant in parts of their analysis (see Monenco Limited, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Engineering, 1985).

It is to be noted that rail access cost is included in Table 5.19 for sites PI-13N and LF-2N. Although no desirable rail options were identified through the constraint mapping analysis, it was deemed desirable to use the preliminary cost data for purposes of consistency in the comparison of siting options.

Table 5.19 provides an opportunity to apply a sensitivity analysis to the earlier assumption that the off-site land acquisition indicator could be measured in land area units and was a less important indicator than cost of rail infrastructure construction. Based upon a comparison of land cost and

TABLE 5.19
OWMC PHASE 4A - TRANSPORTATION
COSTS FOR PREFERRED RAIL ACCESS OPTIONS
TO EACH CANDIDATE SITE

<u>Site</u>	<u>Construction Costs (\$ Millions)</u>	<u>Off-Site Land Costs (\$ Millions)</u>	<u>Total Costs (\$ Millions)</u>
LF-3C	0.893	0.002	0.895
LF-9C	2.129	0.011	2.140
LF-4N	1.348	0.015	1.363
PI-1N	0.944	0.009	0.953
PI-27E	0.390	0.0	0.390
LF-1E	0.677	0.001	0.678
PI-13N ¹	4.280	0.380	4.660
LF-2N ¹	13.330	0.825	14.155

-
- NOTES: 1. Rail access to sites LF-13N and LF-2N was not considered desirable by the site selection team in the Phase 4A constraint mapping analysis; however, cost data available at the time are included for consistency in the overall cost comparison of siting options.
2. These costs are based on preliminary appraisals undertaken by Graydon Rodgers Appraisals Ltd. and contained in the Leon Kentridge Associates 1985 report Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Land Use.

construction cost, it will be noted that land cost represents a maximum of 1.1% of construction cost for the six sites involved in the comparative analysis (excludes PI-13N and LF-2N). This confirms the approach adopted and the greater significance associated with the construction cost measure as applied in the comparative analysis of siting options.

6. CONCLUSIONS

This chapter presents the framework, analysis and results of the process applied by the transportation consultant in the identification of a preferred rail access option to each candidate site.

The synthesis of all the consultants' analyses was carried out by the site selection team in order to select preferred rail options to each site. The details of this activity are described in the report, M.M. Dillon Ltd., Site Selection Process, Phase 4A: Selection of Preferred Site(s) - Site Selection, 1985. The rail options that were selected for the six candidate sites, where the rail service opportunity was judged to be feasible, are identified in Figures 5.2 through 5.7 as the 'preferred rail option'.

Cost data was then refined for the preferred rail access options to include land acquisition cost based upon preliminary land value appraisals. These cost data, which are applied by Monenco Limited during their sensitivity analyses, are set out in Table 5.19. Although rail access to sites LF-13N and LF-2N were not judged to be desirable during the evaluation process, cost values for the rail service opportunity is included in the table. This approach was adopted for purposes of consistency in the next step of site selection.

CHAPTER 6

BASIC ACCEPTABILITY OF CANDIDATE SITES

1. INTRODUCTION

Phase 4A involved a more detailed data collection process than the earlier Phase 3B analysis. Therefore there existed the possibility that the Phase 4A analysis might have uncovered information which could render a siting option unacceptable prior to the detailed comparative analysis of the candidate sites.

From a transportation perspective there was no new information gathered which lead to the elimination of any of the candidate sites. The range of spill and accident involvement values across all options was too small to determine a threshold for site elimination. However, new hydrogeologic/engineering information on site LF-2N in Mississauga led to its rejection as a candidate site, and all other siting combinations which included this site were also eliminated, i.e. PI-13N/LF-2N; PI-1N/LF-2N. These findings are documented in the M.M. Dillon 1985 report Site Selection Process Phase 4A: Selection of a Preferred Site(s), Interim Site Selection Report - Candidate Site LF-2N. Site PI-13N was also rejected due to hydrogeologic/engineering information, however this did not occur until after the comparative analysis had been completed.

This chapter describes the transportation considerations associated with the basic acceptability analysis.

2. TRANSPORTATION INPUTS TO BASIC ACCEPTABILITY

2.1 PURPOSE AND SCOPE

Following the data collection stage of Phase 4A, the information was examined to determine if any new data collected could lead to the elimination of any of the candidate siting options. Consideration was given to the spills, accidents, safety, and costs along the access routes, the feasibility of a rail spur line connection, and the effect of the site's incinerator stack on local airport navigation.

2.2 EXAMINATION OF PHASE 4A TRANSPORTATION DATA

During Phase 4A new information was gathered which allowed a more detailed examination of the transportation risks associated with the OWMC facilities. With this new information it was possible to determine differences between alternative access routes in terms of transport safety, costs, and risk to human health and the environment. It was also possible to provide a preliminary conclusion regarding the feasibility and cost of providing rail service to the candidate sites. However, the range in values obtained was not found to be sufficient in itself to justify the elimination of a siting option for the following reasons:

- ° it was not possible to justify the definition of a threshold value for total system accidents or spills which would form the boundary between acceptability and non-acceptability, because the range of values across all options was too small. Annual spills on the total system ranged between 2.0 to 2.8, and annual accident involvements ranged between 5.3 to 8.3 (see Appendix K of the Transportation Technical Appendices);
- ° the cost of access road improvements was determined not to be a major cost consideration in the selection or rejection of a site. Road improvements ranged between \$106,000 to \$701,200 across all sites (see Appendix H of the Transportation Technical Appendices);

- ° the need for and cost of rail service to a candidate site was not considered essential for site selection as it was viewed as an opportunity rather than a site requirement.

The transportation information which did have an impact on site acceptability was the constraint posed by the incinerator stack on local airport navigation. A preliminary examination of this constraint was carried out during Phase 3B where it was concluded that an incinerator stack on sites LF-4N, and PI-1N may pose a constraint to the navigation of aircraft using the Burlington Airpark located southwest of these sites. The preliminary analysis concluded that further study of the situation was still necessary in Phase 4A.

In Phase 4A, discussions with Transport Canada and airport officials, concerning the proximity of the Milton sites to the Burlington Airpark, revealed the sensitivity of the location of the incinerator stack to the operation of the Airpark, (see discussion in Chapter 3).

Airport officials believed that an incinerator stack (60 to 100 m height) at sites LF-4N or PI-1N could affect safety of aircraft approaching or leaving the Airpark. Since the siting options involving site LF-4N do not include an incinerator, there were no difficulties associated with site LF-4N. However, further investigations into site PI-1N revealed that an incinerator stack would not affect the Airpark's operation if the stack was located in the eastern half of the site.

As a result, transportation considerations did not eliminate any sites on the basis of basic acceptability; however, the location of the incinerator stack at site PI-1N became a consideration in the site boundary refinements discussed in Chapter 3.

3. RESULTS OF BASIC ACCEPTABILITY ANALYSIS

The transportation inputs to the basic acceptability analysis did not lead to the rejection of sites; however, the hydrogeologic/engineering analysis resulted in the elimination of site LF-2N in Mississauga due to insufficient natural containment on-site. Site PI-13N was also rejected for similar reasons, however, this rejection did not take place until after the completion of the comparative analysis of sites. The details of this analysis are contained in the report, M.M. Dillon, 1985, Site Selection Process. Phase 4A: Selection of a Preferred Site(s) - Site Selection, and the Gartner Lee Associates Ltd. report, 1985, Site Selection Process. Phase 4A: Selection of a Preferred Site(s) - Geologic, Hydrogeologic, and Geotechnical Consideration. A specific report on the Mississauga site basic acceptability issue was also published, M.M. Dillon Ltd., May 1984, Site Selection Process Phase 4A: Selection of Preferred Site(s), Interim Site Selection Report Candidate Site LF-2N.

The rejection of site LF-2N eliminated siting options PI-13N/LF-2N and PI-1N/LF-2N. Therefore no further analysis of these two candidate siting options is presented in this report beyond the selection of access roads and rail service, presented in Chapters 4 and 5.

CHAPTER 7

LOCATION OF PHYSICAL CHEMICAL TREATMENT PLANT FOR PARTIALLY INTEGRATED SITING OPTIONS

1. INTRODUCTION

Following Phase 3B there were eight candidate sites producing thirteen possible siting options. The basic acceptability analysis (discussion Chapter 6) eliminated site LF-2N thereby reducing these to nine siting options. Six of the nine remaining siting options are partially integrated siting options (LF-4N/PI-1N, LF-4N/PI-13N, and LF-1E/PI-27E) comprised of two sites each, an LF and a PI site. Each of these partially integrated options can operate with the physical chemical treatment plant on either the PI or the LF sites producing six possible siting options.

The objective of the analysis of these partially integrated siting combinations is to determine the preferred location for the physical chemical treatment plant; either on the LF site (case 3) with the landfill, or on the PI site (case 2) with the incinerator. Integrated sites (case 1) are excluded from this analysis as by definition they are suitable for containing all facilities.

In terms of the transportation requirements, there were important differences between a case 2 and a case 3 site operation. In a case 2 operation, all wastes and process additives/reagents would be transported to the PI site, and only transfer movements would occur between the PI and LF sites. In a case 3

operation a portion of the wastes and additives/reagents would be carried to the PI site (for incineration), and a portion would be carried to the LF site (physical chemical treatment); however, there would be a substantial decrease in the number of transfer movements between the sites since some wastes could be deposited directly into the landfill following treatment at the physical chemical treatment plant. Figure 7.1 illustrates the movements to and between the two components of partially integrated siting options.

The transportation analysis compares the differences between the two operating cases in terms of potential risks along the local and regional access roads due to spills and accidents. On the province-wide access system, beyond the local and regional access routes, there were no differences between the two operating cases as all materials, irrespective of operating case, use the same province-wide routes, and enter the local and regional access routes at the same point.

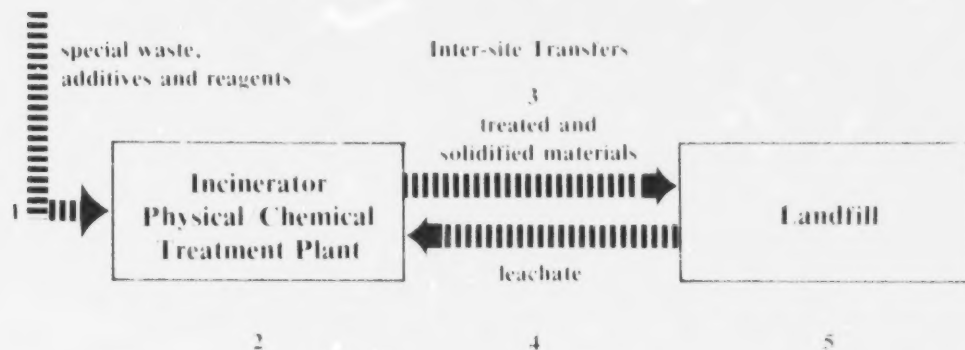
The process of selecting the most appropriate site for the physical chemical plant involved inputs from all members of the site selection team. The methodology by which all these inputs were aggregated, leading to the selection of the most suitable site for the plant, is described in the M.M. Dillon, 1985 report, Site Selection Process - Phase 4A: Selection of Preferred Site(s) - Site Selection. In this report the option evaluation is limited to the transportation-related factors only.

During the analysis the transportation consultant provided transportation data outputs to other site selection consultants to be used in compiling their factors/indicators for option evaluation. Inputs developed within the cost and impact factor groupings were then applied directly by the consultant

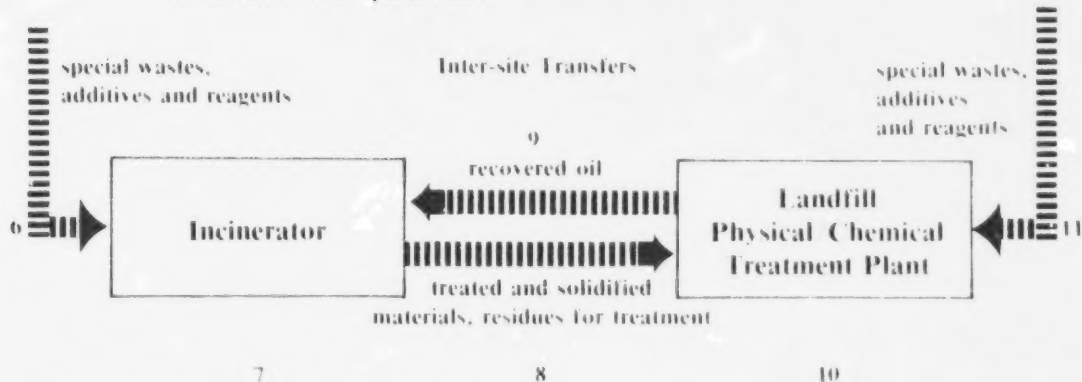
FIGURE 7.1

SCHEMATIC OF PARTIALLY INTEGRATED SITING OPTIONS

OPTION 1: The physical chemical treatment plant with the incinerator and the landfill facility on a separate site.



OPTION 2: The physical chemical treatment plant with the landfill facility and the incinerator on a separate site.



LEGEND

- 1 = access route for transporting - special waste, additives and reagents to the physical chemical treatment plant
- 2 = site of the incinerator and the physical chemical treatment plant
- 3 = inter-site transfer route for the treated and solidified materials from the incinerator and physical chemical treatment plant to the landfill facility
- 4 = inter-site transfer of leachates from the landfill to the incinerator and physical chemical treatment plant
- 5 = site of the landfill facility
- 6 = access route for transporting special wastes and additives and reagents to the incinerator
- 7 = incinerator site
- 8 = inter-site transfer route for transporting treated and solidified materials and residues for treatment from the incinerator to the landfill facility and physical chemical treatment plant
- 9 = transfer route for transporting recovered oil from the physical chemical treatment plant to the incinerator
- 10 = site of the physical/chemical treatment plant and the landfill facility
- 11 = access route for transporting special waste, additives and reagents to the physical chemical treatment plant.

responsible. However, all transportation risk related factors/indicators were aggregated by the transportation consultant and supplied to the site selection consultant as an input to the selection of a preferred partially integrated siting option.

The selected operating arrangement (Case 2 or Case 3) for each partially integrated site was carried into the detailed comparative analysis of all candidate siting options.

2. IDENTIFICATION OF FACTORS AND INDICATORS

2.1 PURPOSE AND SCOPE

The purpose of this section is to identify the evaluation data developed and applied to the comparison of the transportation characteristics associated with the location of the physical chemical treatment plant on either the LF or PI site for each partially integrated candidate siting option. In achieving this objective, this section presents the following information:

- ° the factors and indicators applied to the transportation analysis,
- ° the data input and output requirements to quantify indicators,
- ° the identification of transportation data outputs that were developed and supplied to other consultants to permit the quantification of their respective factors/indicators.

2.2 FACTORS AND INDICATORS APPLIED TO THE TRANSPORTATION ANALYSIS

The two factors and five indicators used in the transportation analysis are shown in Table 7.1. These factors represent potential transportation risks to various receptors along the

TABLE 7.1
OMMC PHASE 4A - TRANSPORTATION
TRANSPORTATION FACTORS, INDICATORS, DEFINITIONS
AND FACTOR GROUPINGS APPLIED TO THE COMPARISON OF SITING OPTIONS

FACTOR GROUPINGS/FACTORS	INDICATORS	DEFINITIONS/SIGNIFICANCE OF FACTORS
A. Risk		
1. Transportation Risk due to Spills: Potential risk to human and environmental receptors along local and regional access roads due to the hazard based spill index for the transport of special wastes, additives and reagents, and inter-site transfers.	a) Road user risk index associated with hazard based spills index. b) Population risk index associated with hazard based spill index. c) Sensitive community and recreational risk index associated with the hazard based spill index. d) Surface water risk index associated with the hazard based spill index.	This factor considers the potential risk to receptors along the access road which may be caused by a spill of special waste, additives and reagents or inter-site transfers as it is transported between the 400-series highways and the site entrances along the preferred access system. The risk indices produced are the product of the hazard based spill index on the local and regional roads and specific receptor data for each indicator.
2. Transportation Risk due to Accident Involvement: Potential risk to road users on local and regional access roads due to the involvement in accidents by trucks carrying special wastes, additives and reagents, and inter-site transfers.	a) Road user risk index associated with OMMC generated trucks involved in accidents.	This factor considers the potential risk to the road users on the local and regional access roads caused by an accident involving OMMC generated vehicles. The user risk index is the product of the number of accident involvements on the local and regional roads in the year 2000 and the year 2000 AADT on each road section.

preferred access routes resulting from a spill of material being transported to an OWMC facility, or the involvement of OWMC generated traffic in motor vehicle accidents. Only the local and regional access roads were considered in the comparison of the operating options because there were no differences between the operating case for partially integrated site on the province-wide access system.

The following subsections discuss the definition, rationale/significance, and data input requirements for each of the factors. Further details are contained in the Factor Sheets in Appendix D of the Transportation Technical Appendices.

2.2.1 Transportation risk due to accident involvement

This transportation factor concerns the potential risks to human health due to the probability of an OWMC generated truck being involved in a motor vehicle accident while transporting the following materials:

- ° special wastes from point of entry onto the selected local and regional access road system to the site,
- ° process additives and reagents from the point of entry onto the selected local and regional access routes to the site, and
- ° partially treated special wastes, process residues, effluent and solidifying wastes transported between partially integrated candidate sites, when using the selected inter-site transfer routes.

This factor was selected for comparing options because differences in vehicle requirements occur only on the preferred access road system.

The indicator developed for this factor is 'risk to other road users'. This indicator is based on the estimated number of OWMC generated vehicles involved in accidents for the return travel movement on the preferred access route. The indicator values are derived from the estimated two-way travel movements required for the processing and handling of all materials, for the year in which OWMC facilities would process 300,000 tonnes/annum of special wastes using total solidification, and the estimated annual daily traffic on the access roads for the year 2000, excluding OWMC generated traffic.

This indicator was selected since it provides a measure of the differences between operating cases in terms of potential risks due to truck transport accident involvements for each partially integrated siting option. For purposes of the accident involvement analysis this indicator considers each OWMC generated truck as having the same potential risk of being involved in an accident regardless of the materials being hauled to sites, and includes the return trip required after material delivery when the trucks are empty. Thus, it provides an overall picture of potential risks for road users due to OWMC generated vehicle accident involvement along the preferred access road.

The following data inputs were required to calculate the indicator values:

- ° the existing accident rates on the preferred access roads;
- ° the forecasted annual trucking movements that would occur on each road section of the preferred access road network as a result of each OWMC facility operation option, and the resulting truck kilometres of travel on each road section due to this operation;
- ° the adjustment factor required to convert the calculated all-vehicle accident rate to the number of OWMC generated trucks involved in accidents; and

- ° the estimated annual average daily traffic along each road section for the year 2000, excluding OWMC generated traffic.

2.2.2 Transportation risk due to spills

This transportation factor involves the development of indices representing potential risk to human health and the environment due to the probability of a spill occurrence (and the relative hazards) during the transport of special wastes, process additives and reagents, and during the transport of treated wastes and process effluents between two components of the partially integrated siting options. The factor deals only with loaded transport of materials because spills of materials could only occur when these conditions prevail. After vehicles are unloaded they would be cleaned and consequently, the return trip has no potential for spill occurrence.

Two types of spillage potential were considered in this factor. One concerns spills as a direct result of motor vehicle accidents while the loaded vehicle is engaged in the haulage of the three commodity types defined. The second spill potential deals with the spills resulting from a transport vehicle container malfunction or mechanical failure. These occurrences may result in the release to the environment of the three commodity types transported.

Both spill potentials result in the release of commodities that may be detrimental to human health or to the environment in general. The four indicators represent the spill potentials and consequences as they relate to human or other environmental effects.

The relative difference in the hazard potential among the three commodities is also considered in calculating the spill probability index; this is defined as the Hazard Index (HI).

The HI values assigned to the three commodity groupings were developed by the risk assessment consultant, Environ Corporation, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Generic Risk Assessment, 1985. The values assigned are:

<u>Commodity Group</u>	<u>HI Value</u>
Special Waste	10
Process Additives and Reagents	1
Process Residues, Effluent, etc.	1

The following data inputs are required to calculate the indicator values:

- ° existing accident rates on the preferred local and regional access roads that would be used for OWMC generated trucking;
- ° forecasted annual trucking movements that would occur on each road section of the preferred access road as a result of each facility operations option, and the resulting truck kilometres of travel on each road section due to these operations;
- ° adjustment factor required to convert the all-vehicle accident rate by road section to the number of OWMC generated trucks involved in accidents;
- ° conditional probability of a spill occurrence given the occurrence of a motor vehicle accident;
- ° frequency of a truck container malfunction or mechanical failure which would produce a spill occurrence due to a non-motor vehicle accident;
- ° population, number of sensitive community and recreational features, and possibility of spill entering the surface water pathway on each road section (all supplied by other consultants); and
- ° the estimated annual average daily traffic along each road section for the year 2000, excluding OWMC generated traffic.

2.3 TRANSPORTATION INPUTS TO OTHER CONSULTANTS

Six data inputs were developed by the transportation consultant for factor and indicator development by other consultants as part of the comparison of locations for the physical chemical plant at a partially integrated site. Each of these is described under the following headings.

2.3.1 Annual number of transport vehicles

To assess the impact of each operations option, the transportation consultant quantified the number of annual truck transport movements required to serve each integrated site or site combinations under each of the three following categories in order to calculate the impact indices applied by others:

- ° special waste vehicle transport;
- ° additives and reagents vehicle transport; and
- ° inter-site transfers between non-integrated sites.

The annual number of truck transport vehicles required was based upon the 10th year of site operation. At that time it was assumed that 300 000 tonnes per annum of special waste, and the required volume of process additives and reagents for total solidification is transported. The results of these analyses are as set out in Appendix G of the Transportation Technical Appendices.

This information was applied by Leon Kentridge and Associates in determining the impacts on residences along the access roads.

2.3.2 Annual transport costs

The transportation consultant provided Monenco Limited with the estimated cost of truck transport requirements broken down into

the cost of transporting special waste, additives and reagents, and inter-site transfer movements for each candidate siting operating combination option, i.e. cases 2 and 3.

The results of these analyses and the cost values obtained are as set out in Appendix G of the Transportation Technical Appendices.

2.3.3 Change in noise level on local and regional access routes

The transportation consultant provided the Institute of Environmental Research with information on the change in noise level along the preferred local and regional access routes to sites and between partially integrated siting options. This information was also applied to the analyses by other consultants. The following base data were included for these calculations:

- ° ambient noise levels based upon 1984 road operations and the forecasted future year 2000 operation without OWMC site operation;
- ° forecasted local and regional access route OWMC generated trucking volumes for the year 2000.

The methods, procedures and the results of these analyses are as set out in Appendix L of the Transportation Technical Appendices, as prepared by S.S. Wilson and Associates, sub-consultant to M.M. Dillon Limited. For purposes of this analysis, the existing and forecasted noise levels identify the location of the 55dBA Leq contour, which is the threshold value for outdoor residential areas between acceptable and unacceptable noise levels for the time period 0700 to 2300 hours, as indicated in the 1978 final report by the Ontario Ministry of the Environment entitled Model Municipal Noise Control By-Law. This approach was adopted as it is anticipated that all OWMC truck transport movements would occur within the period 0700 to 1700 hours.

2.3.4 Change in noise level at candidate site perimeter

Appendix L of the Transportation Technical Appendices also contains information on noise level change anticipated to occur around the site area perimeter for each siting option. In addition to road transport noise, there will be a number of fixed source noise generators in relation to the on-site operating plant. This information was applied in the analyses of other consultants.

To account for the 24-hour plant operation of a physical chemical/incinerator plant (case 2), or a separate incinerator site (case 3), it was necessary to determine the location of both the 50 dBA and 55 dBA Leq noise contours, as each applies to a unique noise level threshold time period identified in the Monenco Limited 1985 report entitled Site Selection Process. Phase 4A: Selection of a Preferred Site(s) - Engineering. Further details on this and the methods and procedures applied are set out in Appendix L of the Transportation Technical Appendices.

2.3.5 Impact indices along the local and regional access road system

The transportation consultant calculated the impact indices for the movement of trucks along the selected local and regional access roads. The following indices relate the impact of an increase in traffic volume on various impact receptors identified and provided by the consultants listed below:

- ° Community and Recreation Features (adjacent and within 800 m zone flanking the local and regional access roads) - Institute of Environmental Research (IER),
- ° Agricultural Vehicle Movements - Ecologistics,
- ° Population (adjacent and within 800 m zone) - Institute of Environmental Research, and
- ° Residences - Leon Kentridge and Associates (indices calculated by LKA based on traffic data supplied by M.M. Dillon - Transportation).

The rationale for the selection of these receptors for use in the impact analysis is described in the Phase 4A reports prepared by the consultants who supplied the impact receptor data. These include, Institute of Environmental Research Inc., Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Social Analysis, 1985, the report prepared by Ecologistics Limited, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Agriculture, 1985, and the 1985 Leon Kentridge Associates report Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Land Use.

The rationale for selecting the two zones for impact analysis is outlined in the Environ Corporation report, Site Selection Process. Phase 4A: Selection of a Preferred Site(s) - Generic Risk Assessment, 1985, and the Site Selection Report (Dillon 1985).

The impact receptor data was combined with the traffic data on each roadway link to produce the impact indices. The impact index value for each site equals the sum of the product of receptor values along each road link and the year 2000 AADT with OWMC generated trucking AADT, divided by the year 2000 AADT without OWMC generated trucking.

The agricultural vehicle movements along each link were multiplied by the link length to convert them to vehicle-kilometres, then multiplied by the change in AADT on each link.

3. DATA COLLECTION AND ANALYSIS

The transportation factors and indicators applied to the comparison of operating options of partially integrated sites, dealt with the estimated increase in traffic on the roadways and the potential risk to human health and the environment due to the potential

for accidents and spills on the roadways used to haul special waste and other process materials to the candidate sites. Details of the data collection process are outlined in Chapter 2 of this report.

In calculating the risk indices for each partially integrated operating option, the following steps were applied:

- ° Collect motor vehicle accident data, and calculate all-vehicle accident rates for local and regional access system on a road section-by-section basis.
- ° Calculate the number of OWMC generated trucks on each road link for each candidate site and operating combination.
- ° Calculate the number of accident involvements per annum (year 2000) for OWMC generated truck transport based on the relationship between all-vehicle accident rates and heavy truck accident involvement rates.
- ° Calculate the number of spills per annum (year 2000) for each of the three commodity groupings carried by OWMC generated trucks for each partially integrated site and operating combination.
- ° Calculate the risk indices for local and regional access road risk receptor data.

3.1 CALCULATE ALL-VEHICLE ACCIDENT RATES

The accident data obtained for the various road sections on the preferred local and regional access route transportation network was supplied by the various roadway agencies for the sections under their jurisdictions. The agencies supplied accident data for the three years 1980 to 1982 inclusive.

The number of accidents occurring on each road section is directly related to many factors including the length of the road section, the annual number of vehicles using the road, and the 'safeness' of the road's geometric features and environment. In order that the road section's accident probability would reflect the roads safety, each section's accident rate was calculated to express the annual number of accidents as a function of the annual vehicle kilometres travelled along the individual road section:

$$\text{Roadways section's annual accident rate} = \frac{\text{Number of accidents per year on road section}}{\text{AADT for road section} \times \text{roadway section length (km)} \times 365 \text{ (day/year)}} \times (1 \times 10^6)$$

Since the 'local' roadways accessing certain sites are assumed to be upgraded to an improved geometric standard equivalent to an Ontario secondary highway, the provincial average accident rate for Ontario secondary highways was used for these road section. As there were very few 'local' access roads of significant length assumed to be used to transport the materials, this assumption has little impact on the overall accident rate for the entire local and regional access routes to these candidate sites.

3.2 ESTIMATE NUMBER OF OWMC GENERATED TRUCKS ON EACH LINK IN ACCESS SYSTEM

To estimate the annual number of accident involvements and spills involving OWMC generated trucks, it was necessary to estimate the annual number of OWMC destined trucks which will travel along each link on the preferred local and regional access route. The following considerations were used in estimating the number of trucks for each link:

- ° amount and types of wastes produced at each municipal waste source area;
- ° size of trucks used to carry special waste, additives and reagents and intersite transfers;
- ° expected routing of waste hauling vehicles between waste source areas and candidate sites;
- ° quantity, source location and vehicle routing by type of additives and reagents transported to candidate sites.

The details of the calculation and results of these analyses are discussed in Appendix G of the Transportation Technical Appendices.

3.3 ESTIMATE ANNUAL NUMBER OF ACCIDENTS INVOLVING OWMC GENERATED TRUCKS

To estimate the annual number of accidents on a road link the link accident rate was applied to the estimated number of OWMC generated vehicles and length of the road link. Since all of the vehicles generated by OWMC are expected to be medium to heavy trucks (i.e. 6 or more tires), the all-vehicle accident rate would not accurately estimate the number of OWMC trucks involved in an accident. Therefore it was necessary to convert the all-vehicle accident rate to a rate for heavy trucks involvements only. The details on the derivation of this conversion factor are described in detail in Appendix J of the Transportation Technical Appendices.

Using the information on the estimated number of OWMC generated trucks on each route link, and the heavy truck accident involvement rate it was possible to estimate the annual frequency of accident involvements on each link which would involve the movement of OWMC generated trucks.

3.4 ESTIMATE ANNUAL NUMBER OF SPILLS INVOLVING OWMC GENERATED TRUCKS

Spills from OWMC generated trucks are the results of two possible spill scenarios:

- ° spill resulting from a motor vehicle accident event,
- ° spill resulting from a non-motor vehicle accident (i.e. equipment failure) event.

The probability of a spill due to a motor vehicle accident event has been based on the findings in the report Pilorusso Research Associates Inc., Background Paper: Transportation of Special Wastes in Ontario, Sept. 1983. This report concluded that in transporting wastes in Ontario the conditional probability of a spill, given that a motor vehicle accident has occurred involving an OWMC generated truck, is 0.196, or one spill for every 5 OWMC vehicles involved in an accident.

The Pilorusso 1983 report also estimated that the probability of a non-motor vehicle accident related spill would be one spill for every one million vehicle kilometres travelled. This probability was based on a sample survey of 5 years of data (1978 to 1982) on the transportation of liquid wastes in Ontario.

The two spill probability values derived from the Pilorusso report were used to estimate the annual number of spills which would result from the transportation of special waste, additives and reagents, or transfer materials for each siting option. The estimated number of spills is documented in Appendix K of the Transportation Technical Appendices.

3.5 CALCULATING RISK INDICES FOR LOCAL AND REGIONAL ACCESS ROADWAYS

The transportation consultant applied the accident and spill frequency data calculated as described in the prior sub-sections, to the receptor data identified along the preferred local and regional access routes. Certain of the receptor data were collected by other consultants, and some by the transportation consultant.

The risk receptor data supplied by other consultants was prepared in the following formats:

- ° Population data (supplied by Institute of Environmental Research):

$$\text{Receptor data for each road section} = (\text{population within 150 m of roadway} \times 10) + (\text{population located 150-500 m from roadway})$$
- ° Sensitive community and recreation features data (supplied by Institute of Environmental Research Inc.):

$$\text{Receptor data for each road section} = (\text{features within 150 m from roadway} \times 10) + (\text{features located 150-500 m from roadway})$$
- ° Possibility of spill entering surface water pathway data (supplied by Gartner Lee Associates Ltd.):

$$\text{Receptor data for each road section} = \text{length of road section where material spills may enter a stream} + \text{total length of road section}$$

The rationale for the development of these risk receptor data and corridor weighting is documented in the Phase 4A reports prepared by each of the consultants supplying the receptor data: Institute of Environment Research Inc., Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Social Analysis, 1985, and Gartner Lee Associates Limited, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Surface Water, 1985.

The rationale for the development of the risk zones along the access roads is discussed in the generic risk assessment report (Environ 1985) and the Site Selection report (Dillon 1985).

In all cases the estimated accident involvement and spill frequencies, and the receptor data were assembled on a link by link basis corresponding to the roadway sections defined by the roadway authorities in their roadway inventories. Indices were calculated according to the following formulae for each site operating case:

- ° Spills Index = Sum for all road sections: (Receptor data for each road section x Annual Estimated No. of spills on each road section x Hazard Index)
- ° Accident Involvement Index = Sum for all road sections (Receptor data for each road section x Annual Estimated No. of accident involvements on each road section)

Appendix B of the Transportation Technical Appendices documents the values of the risk indices for each section along the preferred local and regional access routes, and for each operation option (case 2 and case 3) for the partially integrated siting options. Table 7.2 is a summary of the index values for each siting option.

4. RANKING AND AGGREGATION OF FACTORS AND INDICATORS

4.1 PURPOSE AND SCOPE

The purpose of this activity in the comparative study is to use the transportation factor and indicator values to select the most suitable operating option for each of the partially integrated options from a transportation risk viewpoint. To achieve this objective it is necessary to screen, rank, and aggregate the transportation risk factors and indicators and select the most appropriate option.

This section documents the process followed in order to identify the preferred transportation option.

4.2 SCREENING OF FACTORS AND INDICATORS

A preliminary examination of the transportation risk indices revealed that certain factors or indicators should be screened in the analysis because they do not provide an appropriate basis for the comparison of the partially integrated operating options. The indicators screened for each inter-site comparison are shown in Table 7.3 with a rationale for screening.

TABLE 7.2
OWMC PHASE 4A - TRANSPORTATION
LOCAL AND REGIONAL ACCESS ROAD RISK INDEX VALUES FOR
EACH OPERATION CASE AT EACH PARTIALLY INTEGRATED SITING OPTION

Site	Operating Case	Risk Due to Spills				Risk Due to Accidents
		Road User Risk Index ¹	Population Risk Index	Comm. and Rec. Feature Risk Index	Surface Water Risk Index	Road User Risk Index ¹
PI-1N/ LF-4N	2	12.00	1181.7	0.0	0.721	6.12
	3	11.50	1193.0	0.0	1.043	6.10
PI-13N/ LF-4N	2	8.78	1004.1	0.0	0.579	5.81
	3	11.00	1197.9	0.0	1.023	6.04
PI-27E/ LF-1E	2	1.21	17.2	0.0	0.000	0.76
	3	1.63	24.8	0.0	0.000	0.82

NOTES: 1. The road user risk indices values have been divided by 1 000.

TABLE 7.3
OWMC PHASE 4A - TRANSPORTATION
INDICATORS SCREENED FROM THE COMPARISON OF OPERATION CASES
AT EACH PARTIALLY INTEGRATED SITING OPTION

<u>Site</u>	<u>Indicator Screened</u>	<u>Rationale for Screening</u>
PI-13N/LF-4N	° Risks to Sensitive Community and Recreational Features due to Spills	° No occurrence with either option
PI-1N/LF-4N	° Risk to Sensitive Community and Recreational Features due to Spills	° No occurrence with either option
PI-27E/LF-1E	° Risks to Sensitive Community and Recreational Features due to Spills	° No occurrence with either option
	° Risk of Entry into Surface Water Pathway due to Spills	° No occurrence with either option

In all comparisons the 'risks to sensitive community and recreational feature due to spills' indicator was screened because there were no occurrences of these features along the selected local and regional access routes and transfer routes.

In the comparison of options for site PI-27E/LF-1E the 'surface water pathway risk' indicator was also screened because there were no stream crossings along the selected local and regional access route to this siting option.

4.3 RANKING OF FACTORS AND INDICATORS

In the transportation analysis the partially integrated operation options were compared on the basis of the indicator values under each factor. However, certain indicators are more important from a risk perspective, than the others; therefore the ranking of indicators under each factor has to be taken into account in the comparison. Similarly one transportation risk factor may be more important than the other factors. Table 7.4 indicates the ranking order of the indicators and factors associated with the transportation analysis. These levels do not change from site to site.

The factor and indicator weighting shown in Table 7.4 was derived from the ranking of the factors and indicators. The rationale for the selection of these weights is contained in the report, M.M. Dillon Ltd., 1985, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection.

The factor 'risks due to spills' has three indicators. The 'risk to population' indicator is the highest ranked indicator because their term of exposure would likely be longer than that of the road users. The 'risk to road users' indicator is ranked

TABLE 7.4
OWMC PHASE 4A - TRANSPORTATION
IMPORTANCE LEVELS OF FACTORS AND INDICATORS APPLIED TO
THE COMPARISON OF OPERATION OPTIONS AT PARTIALLY INTEGRATED SITES

<u>Rank Order</u>	<u>Factors</u>	<u>Weighting</u> ¹	<u>Rationale for Ranking</u>
First	° Risks due to Spills	10	° Both events can affect human health, the differences in probability of occurrence and numbers affected is accounted for in the indicator values.
First	° Risks due to Accident Involvements	10	
	<u>Spill Risk Indicators</u>		<u>Rationale for Ranking</u>
First	° Risks to Population due to Spills	5	° Population is a significant receptor with a longer potential exposure time.
Second	° Risks to Road Users due to Spills	4	° Road Users are direct receptors and thus are more important than indirect or environmental receptors.
Third	° Risk of entry into Surface Water due to Spills	2	° Surface water risk factor is an indirect risk with mitigation potential.

NOTE: 1. Weighting rationale are more fully described in the Site Selection report (Dillon, 1985).

second because it represents a potential direct risk to human health and is considered more important than potential risks to the environment which are indirect risk pathways. The 'surface water pathway risk' indicator is an indirect risk, therefore the lowest ranked indicator.

Two factors represent the transportation risk. The 'risks due to spills' factor is ranked equal to the 'risks due to accidents' factor because both factors represent risks to human health. Differences in the probability of the occurrence and number of receptors is accounted for in the indicator values.

5. COMPARATIVE EVALUATION OF PLANT LOCATION OPTIONS

5.1 PURPOSE AND SCOPE

The transportation comparative analysis of the plant location options compared the options on the basis of the factor and indicator scaled values and weightings. Value scaling and indicator aggregation procedures were used in the analysis. The findings of the transportation analysis were synthesized with the findings prepared by the other consultants on the site selection team in order to select the preferred plant location.

This section presents the findings of the transportation analysis and the rationale for selecting plant locations which minimize transportation risks.

5.2 OVERVIEW OF PROCESS

In evaluating the options, the scaled values and weights of the risk factors and indicators for each option were used in order to

aggregate indicators and factors. It was also necessary to determine the features of the options which characterized their differences (i.e. issues and trade-offs). Following this process an option was selected as the preferred option.

A further evaluation took place after all the consultants had selected a preferred option based on their specific factors. The details of this multi-discipline evaluation are discussed in the report: M.M. Dillon Ltd., Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection, 1985.

5.3 EVALUATION OF OPTIONS

The evaluation process involved the scaling and aggregation of indicator values for each transportation factor. The scaling took place to convert the risk indicator values into units of desirability. These units were weighted according to the level of importance of each of the indicators and aggregated to derive a value representing each factor. The following subsections describe each step in the evaluation process and the results of the comparison.

5.3.1 Scaling of indicator values

The index values derived for each indicator were scaled to a common basis to facilitate the aggregation of the indicators for each factor. In each comparison of operating cases for a siting option, the higher indicator value was assigned a scaled value of 1.00; the lower scaled values would then be derived by dividing the lower values by the highest value. This methodology presented the option's indicator values in terms of their proportions to the other options.

5.3.2 Aggregation of indicator values

Indicators for each factor were aggregated by using the sum of the product of the scaled values and the relative indicator weightings divided by the total indicator weighting for the factor. The ranking of the indicators within each factor, described in Section 5.3 of this chapter, became the basis for assigning weights to the indicators. The weighting methodology was dependent upon the potential risk levels defined in the overall site selection report (Dillon, 1985). The indicator weights assigned are shown in Table 7.4.

Since only one indicator was used for the 'risk due to accident involvements on local and regional access roads' factor, no aggregation was necessary.

The indicator scaled values, and weightings are shown in Table 7.5. This table also presents the total aggregated value for each operational option, and the rationale for the transportation ranking of the options. The operating case producing the lower comparative value is preferred over the higher value.

5.4 DISCUSSION OF TRANSPORTATION COMPARISON RESULTS

The risk index values for two of the candidate siting options PI-13N/LF-4N and PI-27E/LF-1E, indicate that a physical chemical treatment plant on the PI site (Case 2) is more desirable. The risk values for site PI-1N/LF-4N show that a physical chemical plant on the PI site (Case 2) is marginally favoured over a plant located on the LF site (Case 3), as the difference in values is small.

For site PI-13N/LF-4N the preference for a case 2 operation is due to the differences in the number of OWMC generated trucks

TABLE 7.5
OWMC PHASE 4A - TRANSPORTATION
RESULTS OF COMPARISON OF PLANT LOCATION OPTIONS FOR
PARTIALLY INTEGRATED SITES

Factor ¹	Indicator	Weight	Scaled Value (and Scaled Value x Weighting) for Each Option					
			PI-1N/LF-4N		PI-13N/LF-4N		PI-27E/LF-1E	
			Case 2	Case 3	Case 2	Case 3	Case 2	Case 3
1. Risk due to Spills	a) Risk to population	5	0.99(4.95)	1.00(5.00)	0.84(4.19)	1.00(5.00)	0.69(3.47)	1.00(5.00)
	b) Risk to Road Users	4	1.00(4.00)	0.96(3.84)	0.80(3.20)	1.00(4.00)	0.74(2.96)	1.00(4.00)
	c) Surface Water Risk	2	0.69(1.38)	1.00(2.00)	0.57(1.14)	1.00(2.00)	0.0 (0)	0.0 (0)
Composite Value for Factor ²			0.94	0.99	0.67	1.00	0.71	1.00
2. Risk to due to Accidents	a) Risk to Road Users	1	1.00(1.00)	0.99(0.99)	0.96(0.96)	1.00(1.00)	0.93(0.93)	1.00(1.00)
	Total Comparative Value:		1.94	1.98	1.63	2.00	1.64	2.00
Transportation Conclusion:			° Case 2 preferred marginally.		° Case 2 preferred.		° Case 2 preferred.	
Rationale:			° Case 2 marginally preferred due to differences in surface water risks; little difference in other risks.		° Case 2 preferred by all indicators, largest difference in terms of surface water.		° Case 2 preferred by all indicators, largest difference in terms of population risk.	

NOTES: 1. Factors weighted equally.

2. Composite Value = $\frac{\text{total of scaled value x weighting}}{\text{total of indicator weights applied}}$

using Britannia Road between the two site entrances and the number of receptors. In case 2 there are about 84% more trucks (mostly special wastes) travelling the 2.3 kilometres between Fourth Line and PI-13N than for case 3; however, in case 3 about 24% to 29% more trucks (mostly special wastes) use the section between Fourth Line and site LF-4N, a distance of 6.3 km producing a higher hazard based spill index. Since there are more receptors along the 6.3 km section of Britannia Road, the potential risks are higher for the case 3 operation.

For site PI 27E/LF-1E the case 2 operation is favoured because there are 30% fewer trucks travelling the 2.7 km between the two sites. The receptors, spills, and accident involvements along this road section are not very high, therefore the differences in the index values are small.

The case 3 operation for site PI-1N/LF-4N is slightly favoured over case 2 in terms of potential road user risks due to spills and accidents only. The differences result from the use of Britannia Road, Highway 25 and First Line Road. In the case 3 operation there is an increase in OWMC generated traffic along Britannia Road between Highway 25 and site LF-4N where the accident rate is high but the number of road users is very low. However, with a case 2 operation there is a large increase in OWMC generated traffic on Highway 25 and First Line where the number of road users is much higher although the spills and accident involvement are lower. The result is that the case 3 operation is slightly preferred in terms of road user risk indicator. All other risk indicators favor case 2 operation because there are few receptors along the section of road where the two options differ in terms of spill indices.

5.5 CONCLUSIONS

After consideration of the trade-offs among the selections made by the various consultants, the site selection team selected the following operation options from the partially integrated siting options (Dillon, 1985):

- ° PI-1N/LF-4N (case 2),
- ° PI-13N/LF-4N (case 2),
- ° PI-27E/LF-1E (case 2).

These three partially integrated siting options and the three remaining integrated sites were then carried forward into the detailed comparative analysis described in Chapter 8.

CHAPTER 8

DETAILED COMPARATIVE ANALYSIS OF SITING OPTIONS

1. INTRODUCTION

The detailed comparative analysis of the six remaining siting options is the final activity in the third step of the Phase 4A site evaluation process. This activity incorporates the results of the comparison of locations for the physical chemical treatment plant, described in Chapter 7, and all previous analyses carried out as part of the refinement of siting options.

The objective of this final activity is to rank the six siting options through the application of the transportation factors and indicators. The process involves the screening, scaling, and aggregation of the indicators and factors associated with the transportation analysis. The transportation analysis also developed data concerning impacts and costs which were applied by other consultants in their comparative analyses.

The analyses by all the members of the site selection team were synthesized in order to identify the major issues and trade-offs involved in the selection of preferred site(s). This synthesis is documented in M.M. Dillon's 1985 report Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection.

This chapter documents the transportation analysis, identifies the existing environment, the factors and indicators applied, the method of analysis, the information supplied to others, and the ranking of the six siting options with respect to the transportation risk considerations. The results of the ranking process are discussed with respect to potential risk to human health, and the sensitivity of site ranking to the relative importance attached to the transportation factors applied.

2. EXISTING ENVIRONMENT

2.1 PURPOSE AND SCOPE

The existing environment along the access routes between the 400-series highways and the candidate site entrances was examined during the summer of 1984. From a transportation perspective, this examination included the following items:

- ° traffic volumes
- ° percentage of medium and heavy trucks (six or more tires)
- ° accident rate
- ° number of lanes
- ° shoulder width
- ° pavement width
- ° R.O.W. width
- ° traffic control

This information provided a basis for estimating the potential transportation risks to the existing environment due to the uses of these roads for the transport of materials to the OWMC candidate sites.

2.2 STUDY AREA OVERVIEW

Chapter 4 of this report outlined the process of selecting a local and regional access route between the 400-series highway and the candidate site entrance. The selected routes are indicated in that chapter. Figures 8.1 to 8.3 show all the selected access routes in the three geographical areas containing the candidate sites.

The selected routes are largely composed of regional roads and provincial highways with, in some instances, short sections of local roads being utilized near the candidate sites. Provincial highways and regional roads were used to the maximum extent possible since they exhibit superior roadway geometrics, platform widths, and greater structural capacity to carry heavy truck loadings.

2.3 STUDY AREA EXISTING ENVIRONMENT

The existing features and traffic characteristics pertaining to the selected local and regional access routes are shown in Tables 8.1 to 8.3. Each table pertains to the geographical regions containing the candidate sites. Figures 8.1 to 8.3 show the location of each of the selected links in each region.

3. IDENTIFICATION OF FACTORS AND INDICATORS

3.1 PURPOSE AND SCOPE

The purpose of this section is to identify the evaluation factors and indicators developed and applied to the detailed comparative analysis of siting options. To this end, this section presents the following information:

TABLE 8.1
 OUMC PHASE 4A - TRANSPORTATION
 EXISTING CONDITIONS ON SELECTED LOCAL AND REGIONAL ACCESS ROUTES
 NORTHERN REGION (SITES PI-1M, PI-13M AND LF-4M)

LINK DESCRIPTION ³ (LENGTH)	APPRAISAL SHEET NO.	1983 ADOT ¹ (2-way)	DHV ¹ (2-way)	% HEAVY ² TRUCKS	1980-1982 ¹ Acc/mi11 veh. km	NUMBER ¹ OF LANES	PAVED ¹ WIDTH (m)	SHOULDER ¹ WIDTH (m)	R.O.W. ¹ WIDTH (m)	COMMENTS
B. Highway 25										
1. QEW to Hwy 5 (4.0 km)	MTC-25400-0.0	8,200	900	11	0.8	2	7.3	3.0	37	Traffic signals at QEW ramps
2. Hwy 5 to PI-1M (6.4 km)	MTC-25410-0.0	7,200	800	8	0.8	2	7.3	3.0	37	
3. PI-1M to Britannia (1.0 km)	MTC-25410-0.0	7,200	800	8	0.8	2	7.3	3.0	37	
C. Fourth Line (Local/Regional Road #4)										
1. Hwy 401 to Main (0.5 km)	HAL-4303	3,400	340	15	4.4	5	15.6	4.8	36.2	James Snow Parkway; stop sign at Main
2. Main to Derry (1.9 km)	HAL-4301	180	20	15	0.0	2	5.7	0.5	20.0	Loose surface; stop sign at Derry; level rail crossing
3. Derry to Britannia (Local) MILT-237 (3.2 km)		210	20	15	N/A	2	6.1	0.75	17.1	Stop sign at Britannia Road
D. Britannia Road (Regional Road #6)										
1. Fifth Line to Fourth Line (1.3 km)	HAL-6303	1,180	120	11	1.3	2	6.1	0.9	20.1	
2. Fourth Line to Third Line (1.4 km)	HAL-6303	1,180	120	11	1.3	2	6.1	0.9	20.1	

TABLE 8.1
ONMC PHASE 4A - TRANSPORTATION
EXISTING CONDITIONS ON SELECTED LOCAL AND REGIONAL ACCESS ROUTES
NORTHERN REGION (SITES PI-1N, PI-13N AND LF-4N)
(continued)

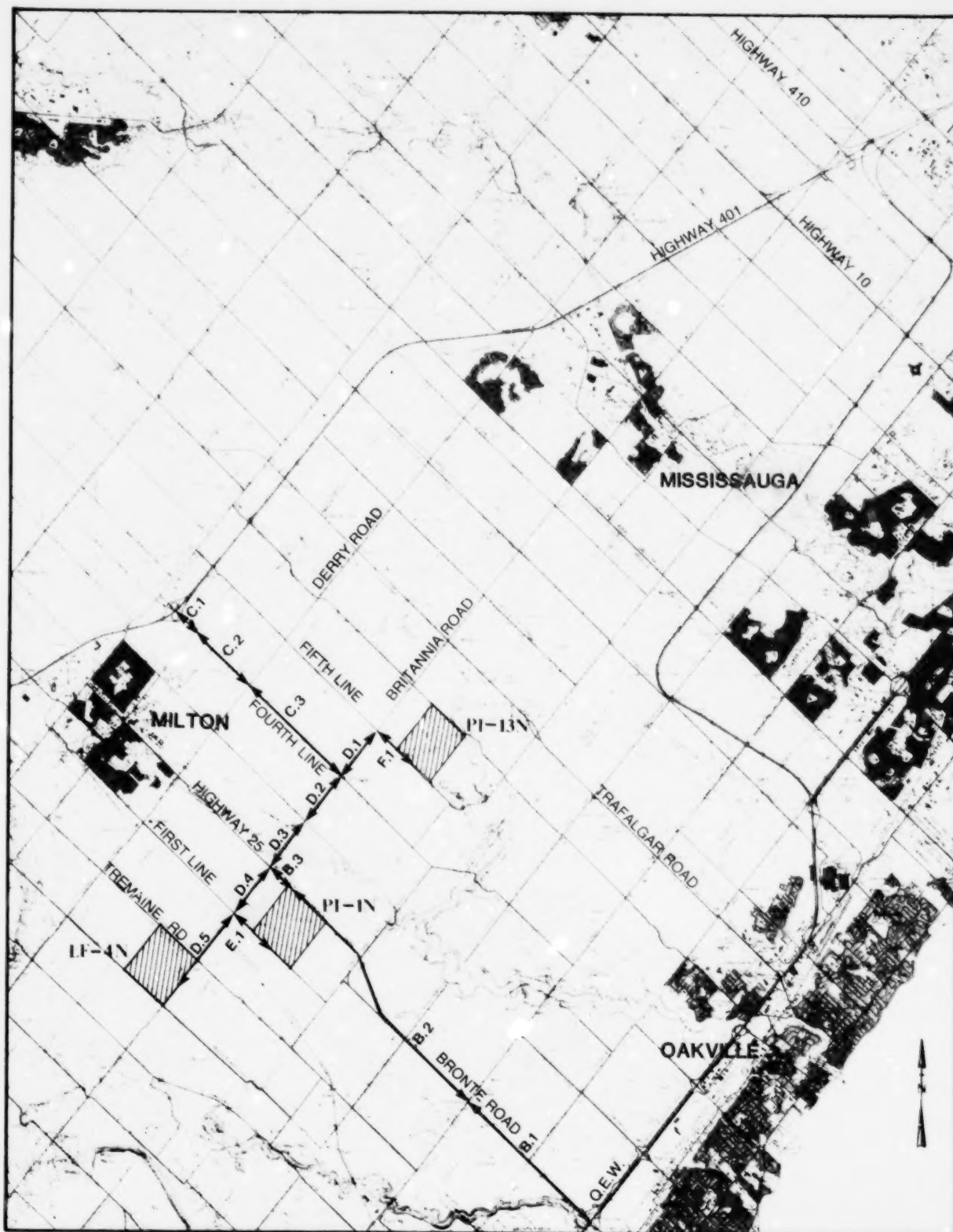
LINK DESCRIPTION ³ (LENGTH)	APPRAISAL SHEET NO.	1983 ADOT ¹ (2-way)	DHV ¹ (2-way)	% HEAVY ² TRUCKS	1980-1982 ¹ Acc/mill veh. km	NUMBER ¹ OF LANES	PAVED ¹ WIDTH (m)	SHOULDER ¹ WIDTH (m)	R.O.W. ¹ WIDTH (m)	COMMENTS
3. Third Line to Hwy 25 (1.4 km)	HAL-6301	1,180	120	11	3.5	2	6.7	1.8	26.2	Stop sign at Highway 25
4. Hwy 25 to First Line E. (1.3 km)	HAL-6311	300	30	20	6.2	2	6.2	1.3	20.0	Stop sign at First Line; poor road condition
5. First Line to LF-4N (2.2 km)	HAL-6309	400	40	7	8.1	2	6.0	1.3	20.0	Stop sign at Trémaine; jog intersection; level rail crossing; poor road condition
E. FIRST LINE E (local)										
1. PI-1N to Britannia (1.0 km)	MILT-231	680	70	3	N/A	2	6.1	0.75	20.1	
F. FIFTH LINE (local)										
1. Britannia to PI-13N (1.0 km)	MILT-242	250	25	23	N/A	2	6.4	0.75	20.1	Stop sign at Britannia

NOTES:

1. Source: road agencies/appraisal sheets
2. Source: data collected by consultant during traffic study 1984
3. Refer to Figure 8.1 for location of links

TABLE 8.2
OWMC PHASE 4A - TRANSPORTATION
EXISTING CONDITIONS ON SELECTED LOCAL AND REGIONAL ACCESS ROUTES
CENTRAL REGION (SITES LF-9C and LF-3C)

LINK DESCRIPTION ³ (LENGTH)	APPRAISAL SHEET NO.	1983 AADT ¹ (2-way)	DHV ¹ (2-way)	% HEAVY ² TRUCKS	1980-1982 ¹ Acc./mi ¹¹ veh. km	NUMBER ¹ OF LANES	PAVED ¹ WIDTH (m)	SHOULDER ¹ WIDTH (m)	R.O.W. ¹ WIDTH (m)	COMMENTS
A. Highway 20										
1. RR#24 to LF-9C (5.3 km)	MTC-23730-2.9	2,900	391	15	1.4	2	7.5	2.5	20.0	Traffic signals at RR#24
2. LF-9C to RR#65/#27 (4.0 km)	MTC-23730-2.9	2,900	391	15	1.4	2	7.5	2.5	20.0	4 way stop at RR#65/RR#27
B. Niagara Regional Road No. 24 (Vineland Townline Road)										
1. QEW to RR#81 (3.8 km)	NIA-2431	7,190	790	13	2.3	2/4	14	0	20.1	2 parking lanes
2. RR#81 to Moyer (0.7 km)	NIA-2428	6,990	770	14	1.3	2/4	14	0	20.1	2 parking lanes; traffic signals at RR#81
3. Moyer to RR#73 (1.1 km)	NIA-2425	6,990	770	14	1.3	3	10.4	2.4	26.2	Southbound truck climbing lane
4. RR#73 to Ninth Ave (3.5 km)	NIA-2422	6,230	748	18	2.1	2	6.75	2.75	26.2	
5. Ninth Ave to RR#216 (3.0 km)	NIA-2419	5,420	600	18	2.1	2	6.7	2.15	30.5	
6. RR#216 to Hwy 20 (4.1 km)	NIA-2416	4,580	500	18	1.3	2	6.7	2.15	30.5	Traffic signals at Highway 20
C. Regional Road #65										
1. Hwy 20 to Krick Road (3.0 km)	NIA-6513	840	134	17	0.2	2	6.7	2.75	26.2	4 way stop at Hwy 20



OWMC Ontario
Waste Management
Corporation

Consultant

DILLON

1 0 1 2 3 4 5 kilometers

NORTHERN REGION

PHASE 4A

EXISTING CONDITIONS

FIGURE 8.1

TABLE 8.2
OMMC PHASE 4A - TRANSPORTATION
EXISTING CONDITIONS ON SELECTED LOCAL AND REGIONAL ACCESS ROUTES
CENTRAL REGION (SITES LF-9C and LF-3C)
(continued)

LINK DESCRIPTION ³ (LENGTH)	APPRAISAL SHEET NO.	1983 ADOT ¹ (2-way)	DHV ¹ (2-way)	% HEAVY ² TRUCKS	1980-1982 ¹ Acc./mill veh./km	NUMBER ¹ OF LANES	PAVED ¹ WIDTH (m)	SHOULDER ¹ WIDTH (m)	R.O.W. ¹ WIDTH (m)	COMMENTS
D. Krick Road (local)										
1. RR#65 to 0.6km south (0.6 km)	W.L.-131	44	-	10	N/A	2	4.6	0.6	20.0	Stop at RR#65
2. 0.6km south of RR#65 to Vaughan Road (0.8 km)	W.L.-161	35	-	10	N/A	1	3.1	0.6	12.2	Earth road; no control at Vaughan Road
3. Vaughan to Elcho (1.4 km)	W.L.-153	64	-	10	N/A	2	5.8	0.6	20.0	No control at Elcho Road
4. Elcho to LF-3C (0.7 km)	W.L.-154	66	-	10	N/A	2	5.2	0.6	20.0	

NOTES:

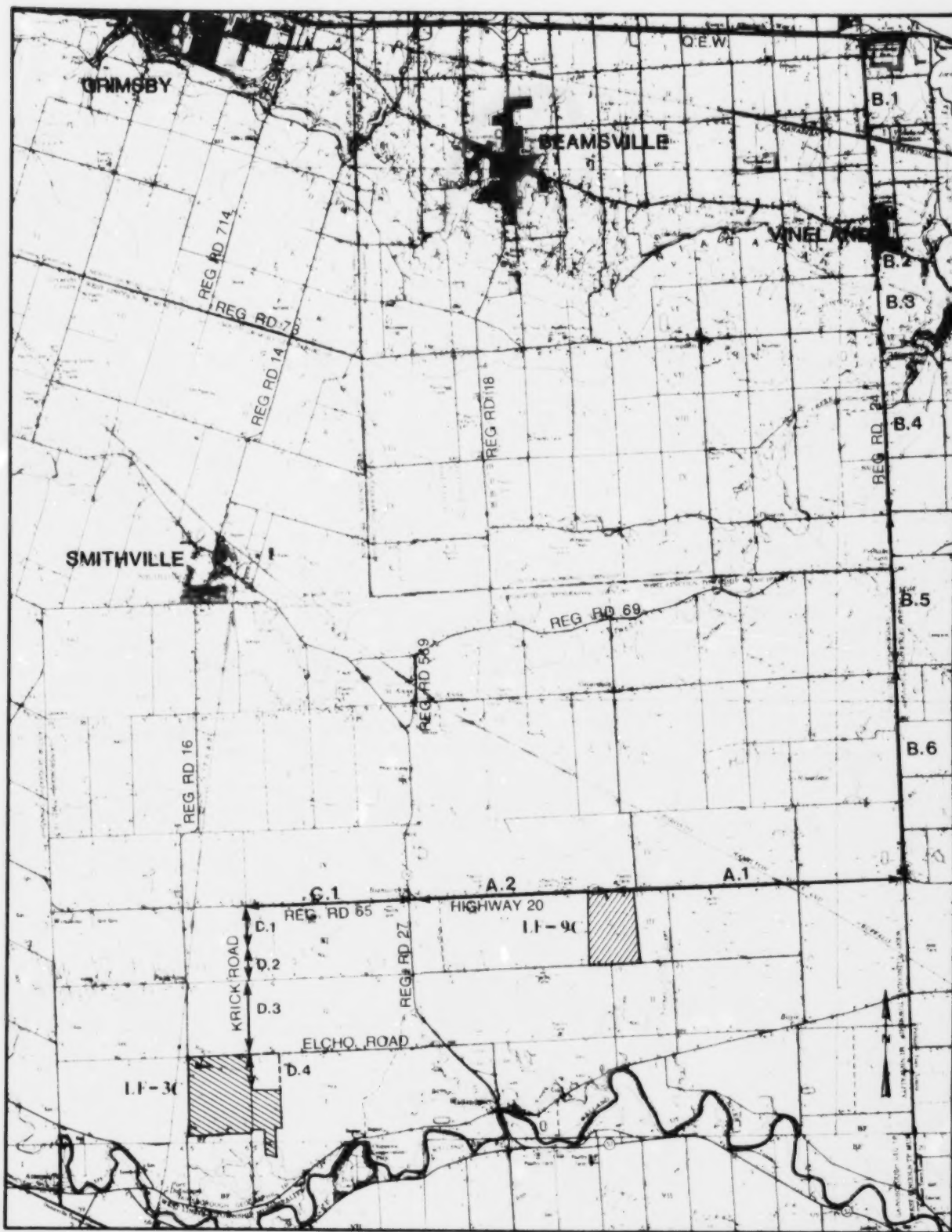
1. Source: road agencies/appraisal sheets
2. Source: data collected by consultant during traffic study 1984
3. Refer to Figure 8.2 for location of links

TABLE 8.3
OWMC PHASE 4A - TRANSPORTATION
EXISTING CONDITIONS ON SELECTED LOCAL AND REGIONAL ACCESS ROUTES
EASTERN REGION (SITES LF-1E AND PI-27E)

LINK DESCRIPTION ³ (LENGTH)	APPRAISAL SHEET NO.	1983 ADT ¹ (2-way)	DHV ¹ (2-way)	% HEAVY ² TRUCKS	1980-1982 ¹ ACC/mi/h	NUMBER ¹ OF LANES	PAVED ¹ WIDTH (m)	SHOULDER ¹ WIDTH (m)	R.O.W. ¹ WIDTH (m)	COMMENTS
A. Regional No. #47 (Biggar Road/ Lyon's Creek Road)										
1. QEW to RR#98 (0.4 km)	NIA-4710	4,081	450	14	2.3	2	7.3	3.0	30.5	Stop sign at RR#98 and at QEW ramps
2. RR#98 to PI-27E (0.8 km)	NIA-4707	354	35	7	1.3	2	6.1	0.8	20.1	Lower quality regional road
3. PI-27E to Crowland (0.9 km)	NIA-4707	354	35	7	1.3	2	6.1	0.8	20.1	Level rail crossing through intersection with Crowland
B. Crowland Avenue (local)										
1. RR#47 to Carl Road (1.0 km)	N.Falls-60011	38	-	25	N/A	2	6.1	1.2	20.0	Stop at RR#47; level rail crossing at RR#47; stop at Carl
C. Carl Road (local)										
1. Crowland to Morris (0.8 km)	N.Falls-60038	180	-	12	N/A	2	6.7	0.9	26.2	

NOTES:

1. Source: road agencies/appraisal sheets
2. Source: data collected by consultant during traffic study 1984
3. Refer to Figure 8.3 for location of links



- ° the identification of transportation factors and indicators;
- ° the data input and output requirements to apply the factors and indicators; and
- ° the identification of transportation data inputs that were developed and supplied to other consultants to permit the quantification of their respective factors.

3.2 TRANSPORTATION FACTORS AND INDICATORS

Largely the same transportation factors and indicators developed during the comparative analysis for the location of the physical chemical treatment plant, described in Chapter 7, are applied here. However, two new factors are introduced dealing with the potential for spills and OWMC generated truck accident involvement on the province-wide access road system. In addition, an indicator representing the risk to 'hydrogeologic sensitive lands' due to spills was added to the "Transport Risks due to Spills" factor, and the indicator 'surface water risk index' is replaced by the indicator 'surface water suitability'. The new indicators and factors are shown in Table 8.4.

Each of the new transport factors and indicators is discussed in this sub-section. The individual factor/indicator sheets are included in Appendix D of the Transportation Technical Appendices, within the group "factors for site selection". The appendix discussion provides specific information in relation to the selected factors in terms of the following:

- ° the indicator;
- ° indicator definition;
- ° rationale/significance;
- ° sources of input information;
- ° comments/assumptions and limitation;
- ° area of study.

TABLE 8.4
OUMC PHASE 4A - TRANSPORTATION
NEW TRANSPORTATION FACTORS, INDICATORS, DEFINITIONS
AND FACTOR GROUPINGS APPLIED TO THE COMPARISON OF SITING OPTIONS

FACTOR GROUPINGS/FACTORS	INDICATORS	DEFINITIONS/SIGNIFICANCE OF FACTORS
A. Risk		
1. Probability of transport accident involvement along the province-wide access system involving truck traffic to/from site.	a) The estimated annual number of transport vehicles involved in accidents while carrying either special wastes, additives and reagents, or transferring processed wastes and residues between sites; and then returning empty to the point of trip origin.	This factor considers the possibility of an accident involving the trucks generated by an OUMC facility. The accident probability will differ for each site due to their distance from waste sources and the accident rates along the roadways over which materials are hauled.
2. Hazard Based Spill Index for special waste, additive and reagent, and inter-site transfers when hauling to or between candidate sites along the province-wide system annually.	a) The hazard based spill index for accident related special waste, additive and reagent, and inter-site transfer spills. b) The hazard based spill index for non-motor vehicle accident related special waste, additive and reagent, and inter-site transfer spills.	This factor considers the possibility of a spill and the relative hazard of a spill of special wastes, additives and reagents or inter-site transfers as they are transported to or between candidate sites.
3. Transportation Risk due to Spills along the local and regional access roads (2 new indicators introduced at this stage).	a) Surface water suitability risk index associated with hazard based spill index (replaces surface water risk). b) Sensitive hydrogeologic lands risk index associated with hazard based spill index.	These new indicators consider the potential risk to down stream uses, and sensitive hydrogeologic lands due to the spill of special wastes, additives and reagents, and inter-site transfers of materials along the local and regional access roads.

NOTES: 1. The province-wide access system does not include the local and regional access road system.

Due to the scope of data provided within Appendix D of the Transportation Technical Appendices, the discussion contained herein will be limited to the definition, rationale/significance and data input requirements of each new factor and indicator. Chapter 2 of this report provided information with regard to the assumptions and data collection. Subsequent sections deal with the analysis required to quantify the indicator values.

3.2.1 Potential for the involvement of an OWMC generated truck in an accident along the province-wide access system

This transportation factor concerns the potential of an OWMC generated truck being involved in a motor vehicle accident during the transport of materials:

- ° special wastes from municipal source generation areas to point of entry onto the selected local and regional access road system;
- ° process additives and reagents from their source to point of entry onto the selected local and regional access routes, and
- ° the transport of partially treated special wastes, process residues, effluent and solidifying wastes between non-integrated candidate sites, when these movements occur on the province-wide system.

The indicator developed for this factor is the estimated number of OWMC generated vehicles involved in accidents for the return travel movements described above. The indicator values are based upon the estimated two-way travel movements required for the processing and handling of all materials, for the year in which OWMC facilities would process 300,000 tonnes/annum of special wastes, and assuming total solidification.

This indicator was selected since it provides a measure of the relative safety of the total truck transport requirements for each candidate site and site combination. For purposes of the accident analysis this indicator includes the return trip required after material delivery when the trucks are empty. The hazard

index associated with the three material type groupings is not applied in relation to accident involvement events, as it is only a concern to spill events. On the other hand, it is necessary to consider two-way travel in that accident events may occur when vehicles are loaded or empty. Thus, it provides an overall indication of vehicle accident involvement frequency in relation to the total trucking requirements for each candidate site or combination.

The data inputs required to calculate the indicator values include:

- ° the existing accident rates on all roadways that would be used for OWMC generated traffic;
- ° the forecasted annual trucking movements that would occur on each road section of the Ontario road network as a result of OWMC facility operation, and the resulting truck kilometres of travel on each road section due to this operation; and
- ° the adjustment factor required to convert the road link all-vehicle accident rate to the number of OWMC generated traffic involved in accidents.

3.2.2 Hazard based spill index for transport of materials along the province-wide access system

This transportation factor involves the development of information on the probability of a spill occurrence (and the relative hazards) during the transport of special wastes, process additives and reagents, and during the transport of treated wastes and process effluents between the two components of a partially integrated OWMC siting option. The factor deals only with loaded transport of these materials because spills of these materials could only occur when these conditions prevail. After vehicles are unloaded they would be cleaned, and consequently the return trip has no potential for spill occurrence.

Two indicators were developed under this factor. The first concerns the annual hazard based spill index which would be a direct result of motor vehicle accidents while the loaded vehicle is engaged in the haulage of the three commodity groupings defined. The second indicator deals with the hazard based spills resulting from a transport vehicle container malfunction or mechanical failure while in-transit. These occurrences may also result in the release to the environment of the commodities transported.

Both spill indicators result in the release of commodities that may be detrimental to human health or to the environment in general. Since the consequences are similar and relate to human or other environmental effects, both indicators are a component of the risk factor grouping.

The relative difference in the hazard potential among the three commodity groups is also considered in calculating the spill index; this is known as the Hazard Index (HI). Special wastes are assigned a value of 10, while the other two commodity groupings have a value of 1 each (detailed in Chapter 7).

The following data inputs were required to calculate the indicator values:

- ° the existing all-vehicle accident rates on all roadways that would be used for OWMC generated trucking;
- ° the forecasted annual trucking movements that would occur on each road section of the Ontario road network as a result of OWMC facility operations, and the resulting truck kilometres of travel on each road section due to this operation;
- ° the adjustment factor required to convert the all-vehicle accident rate by road section to the number of OWMC generated trucks involved in accidents;
- ° the conditional probability of a spill occurrence given the occurrence of a motor vehicle accident; and
- ° the probability of a truck malfunction or mechanical failure which would produce a spill occurrence due to a non-motor vehicle accident while in-transit.

3.2.3 Risk to surface water suitability due to spills on the local and regional access roads

The indicator values for surface water suitability were supplied by Gartner Lee Associates. This indicator was the aggregation of two sub indicators that apply to the local and regional access roads:

- ° surface water risk index due to hazard based spills, (developed in Chapter 7), and
- ° downstream water uses.

The development of these two sub indicators and their aggregation is discussed in the report, Gartner Lee Associates Ltd., 1985, Site Selection Process, Phase 4A: Selection of Preferred Site(s) - Surface Water.

3.2.4 Risk to sensitive hydrogeologic lands due to spills on the local and regional access roads

This indicator represented the risk to sensitive hydrogeologic lands along the preferred local and regional access routes due to the hazard based spill indices calculated for each road section. Details on the development and significance of the hydrogeologic lands receptor is contained in the report, Gartner Lee Associates Ltd. 1985, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Geologic, Hydrogeologic, and Geotechnical Considerations.

3.3 TRANSPORTATION INPUTS TO OTHER CONSULTANTS

Data inputs were developed by M.M. Dillon - Transportation for factor and indicator application by other consultants as part of their comparison of siting options. A portion of these data were supplied as part of the partially integrated siting option comparison and Chapter 7 includes a description of these data supplied to others.

3.3.1 Data carried forward from the comparison of partially integrated sites operation options

A large portion of the data supplied to other consultants was developed during the comparison of locations for the physical chemical treatment plant at partially integrated siting options and is described in Chapter 7. During the comparative analysis of the candidate sites, the following information was also developed for the integrated siting options:

- ° Annual Number of Transport Vehicles,
- ° Annual Transport Costs,
- ° Change in Noise Level on Local and Regional Access Routes,
- ° Change in Noise Level at Candidate Site Perimeter,
- ° Impact Indices Along the Local and Regional Access Road System.

3.3.2 New data prepared for the comparative analysis of siting options

A portion of the data supplied to others was developed following the comparison of plant locations at partially integrated sites. This information was not necessary during the earlier stage because it indicates differences between sites and not operation options. The following subsections describe these data inputs.

a) Rail spur line costs. The transportation consultant provided cost information to the engineering consultant (Monenco Ltd.) regarding the construction of a rail spur line to connect the candidate sites to a national rail line for their sensitivity analyses (these costs were not used in the siting option comparison). The details on the cost calculation for each rail option are described in Chapter 5. The cost (in 1984 dollars) includes the following items:

- ° turnout connection to national railway line;
- ° supply and installation of rail trackage between main line and plant site;
- ° supply and installation of level rail/roadway crossing safety equipment;
- ° cost of additional off-site land required to accommodate rail spur line.

However, the cost does not include any on-site construction of railway storage yards or switching devices.

The right-of-way area required for the rail spur line was also determined from the national rail line to the candidate site boundary. An 18.3 m right-of-way width was assumed for purposes of this calculation. The cost of purchasing this right-of-way was estimated by a land appraisal firm for input to the cost factors as discussed in Chapter 5.

b) Access road improvement costs. The transportation consultant provided cost information on access road improvement for application by Monenco (the engineering consultant) in the detailed comparison of siting options. The cost reflects the anticipated costs (in 1984 dollars) for the upgrading of the local and regional access roads to the site. In addition, the cost of additional land outside of the existing road right-of-way, which would be required to accommodate the road improvements proposed, was also provided as input to the overall cost estimate. The methodology and results of the road improvement cost calculations are detailed further in Appendix H contained in the Transportation Technical Appendices, and summarized in Chapter 4 of this report.

The road improvement cost requirements were based on the impact of OWMC generated truck traffic on the road's estimated traffic and geometric conditions in the year 2000 when the OWMC facility is expected to be processing 300,000 tonnes of special

wastes per year. Structural improvements are costed for the "local" roads only, however other improvements to regional roadways and provincial highways are also included, as well as site entrance costs.

The road geometric standards used to establish geometric improvements were based on the MTC standards for rural and urban roadways as they applied to the road's environment and traffic volumes. The structural component of the roadway improvements were based on MTC standards for flexible pavement design as they applied to the volume of trucks using the roadway and anticipated increase in truck volume with and without the OWMC generated trucking.

c) Surface water risk index along the local and regional access road system. M.M. Dillon - Transportation supplied information to Gartner Lee Associates Ltd. (surface water consultant) to operationalize a sub indicator associated with the indicator 'surface water suitability'.

This indicator was composed of two sub indicators: 'surface water risk index due to spills along local and regional access roads', and 'downstream water uses'. M.M. Dillon - Transportation calculated the surface water risk index due to spills, based upon the estimated number of spills along each section of the access route, and the surface water receptor data supplied by Gartner Lee and Associates. The method of calculating this sub indicator value is described in Chapter 7 of this report. The details of the surface water receptor data derivation, and the aggregation of the two sub indicators, are described in the Gartner Lee Associates Ltd. 1985 report, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Surface Water.

4. DATA COLLECTION AND ANALYSIS

4.1 DATA ANALYSIS CARRIED FORWARD FROM EARLIER ANALYSES

Much of the data collection and analysis required for the comparative analysis of the candidate sites was carried out during the earlier stages of the Phase 4A process. The earlier analyses dealt with the transportation risks associated with spills and accidents involving OWMC generated truck traffic along the local and regional access roads. The details of this earlier analysis are described in Chapter 7.

4.2 NEW DATA ANALYSIS

Two factors and two additional indicators were introduced in the detailed site comparative analysis. The analysis required to operationalize these new factors and indicators was similar to the process described in Chapter 7. The following subsections describe the additional analysis carried out for these new components of the transportation analysis.

4.2.1 Province-wide accident involvements and spills

During the comparative analysis of sites, an additional study area was introduced - the Province-wide Access Network. Accident involvements and spills for this new study area were calculated in the same manner as they were for the local and regional access system, however it was decided that receptor data would not be required along the province-wide routes (see discussion in Section 8.2 of this Chapter).

Actual 1980-1982 accident rates for all the provincial and regional roads used to transport special wastes, additives and reagents, and intersite transfers were used in the province-wide analysis. This information was compiled and analyzed in the same

manner as the local and regional access road data to calculate OWMC generated truck accident involvement and spill probabilities.

4.2.2 Transportation risk to sensitive hydrogeologic lands due to spills along the local and regional access routes

The Transportation Spill Risk factor was enhanced during the comparative analysis of the siting options by the addition of an indicator dealing with the risk to sensitive hydrogeologic lands due to spills of material being transported by OWMC generated trucks. The method of calculating this indicator is identical to the method applied to the other spill risk related indicators described in Chapter 7.

The receptor data for this indicator was prepared by Gartner Lee Associates and is detailed in their 1985 report Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Geologic, Hydrogeologic, and Geotechnical Considerations. The format of the receptor data input to the risk calculation is as follows:

Hydrogeologic receptor data = Length of Sensitive Hydrogeologic
Lands along each Road Section
+ Length of Road Section

The corresponding risk calculation for a given site was as follows:

Risk to Hydrogeologic Lands = Sum for all links (Receptor data on
each road section x hazard based
spill index along link)

4.2.3 Risk to surface water suitability along the local and regional access routes due to spills

The data for this indicator was supplied by Gartner Lee Associates Ltd. It represents the aggregation of two sub indicators dealing with risk of a spill entering a stream crossing, and down stream uses along the stream. The development and aggregation of these sub indicators is described in their report (Gartner Lee 1985b).

4.3 RESULTS OF TRANSPORTATION ANALYSIS

Table 8.5 lists the indicator values for all the factors applied to the transportation analysis. These raw data values are carried into the indicator and factor aggregation process described in the following sections.

5. RANKING AND AGGREGATION OF FACTORS

5.1 PURPOSE AND SCOPE

Section 3 described the transportation factors and indicators which are applied to the site selection process. These are only a few of the total number of factors and indicators developed by the multi-disciplinary site selection team. In applying these transportation factors and indicators to the site selection process, a systematic approach is taken to aggregate and rank the various factors involved.

The transportation analysis dealt with the aggregation of factors and indicators related to the 'Transportation Risk' factor grouping. This factor grouping was combined with all other risk-related factor groupings to derive an overall risk component. The risk component was then combined with the impact and cost components to determine the preferred siting option. Transportation inputs were also considered in the cost and impact components, although M.M. Dillon - Transportation was not involved in factor aggregation for these areas. The described process is illustrated in Figure 8.4, and the details of the factor grouping aggregation is more fully described in the report, M.M. Dillon Limited, 1985, Site Selection Process Phase 4A, Selection of a Preferred Site(s) - Site Selection.

TABLE 8.5
OMMC PHASE 4A - TRANSPORTATION
FACTOR/INDICATOR VALUES FOR EACH SITING OPTION
IN COMPARATIVE ANALYSIS

Factor	Indicator	Values at Each Siting Option						
		LF-9C	LF-3C	LF-1E	PI-1N/ LF-4N	PI-13N/ LF-4N	PI-27E/ LF-1E	
1. Province-wide Hazard based Spill Index	a) Spills Index due to motor vehicle accidents	3.226	3.226	5.43	1.967	1.967	5.430	
	b) Spills Index due to non-motor vehicle accidents	10.447	10.447	15.582	10.488	10.488	15.582	
2. Risks due to Hazard Based Spills on Local and Regional Access Routes	a) Population Risk Index	11102.3	13512.9	26.6	1181.7	1004.1	17.2	
	b) Road User Risk Index	51.29	57.06	1.73	12.00	8.78	1.21	
	c) Sensitive Uses Risk Index	12.25	25.05	0	0	0	0	
	d) Surface Water Suitability Risk Index ²	4	5	1	3	3	1	
3. Province-wide Accident Involvements	e) Sensitive Hydrogeologic Lands Risk Index	1.133	1.133	0	0.164	0.036	0	
	a) Annual Accident Involvements by OMC generated trucks	4.36	4.36	6.92	2.44	2.44	6.92	
4. Risks due to Accident Involvements on Local and Regional Access Routes	a) Road User Risks ¹	28.86	29.18	0.84	6.12	5.81	0.76	

NOTES: 1. Values for road user indices are divided by 1000.

2. Values derived from suitability levels defined by Gartner Lee and Associates Ltd. 1985e.

5.2 INDICATOR/FACTOR AGGREGATION PROCESS

Figure 8.4 illustrates the manner in which the work by M.M. Dillon - Transportation integrates with the work by the other disciplines in aggregating indicators and factors towards the selection of the preferred site(s). Although only the indicators of the transportation risk related factors were aggregated by M.M. Dillon - Transportation, the transportation consultant supplied inputs to the factors applied by other consultants.

The aggregation process used in the transportation detailed comparative analysis involved the application of indicator scaling and weighting to derive factor suitability rankings for each of the sites in terms of the four transportation risk factors:

- ° Province-wide Hazard Based Spill Risk Index,
- ° Local and Regional Access Road Hazard Based Spill Risk Index,
- ° Province-wide Accident Involvements Risk Index, and
- ° Local and Regional Access Road Accident Involvement Risk Index.

The factor suitability levels and the relative weighting of these factors was used to aggregate the spill related factors and the accident involvement related factors. Finally, the spill and accident involvement factors were aggregated to derive site rankings in terms of Transportation Risks.

5.3 SCREENING OF INDICATORS

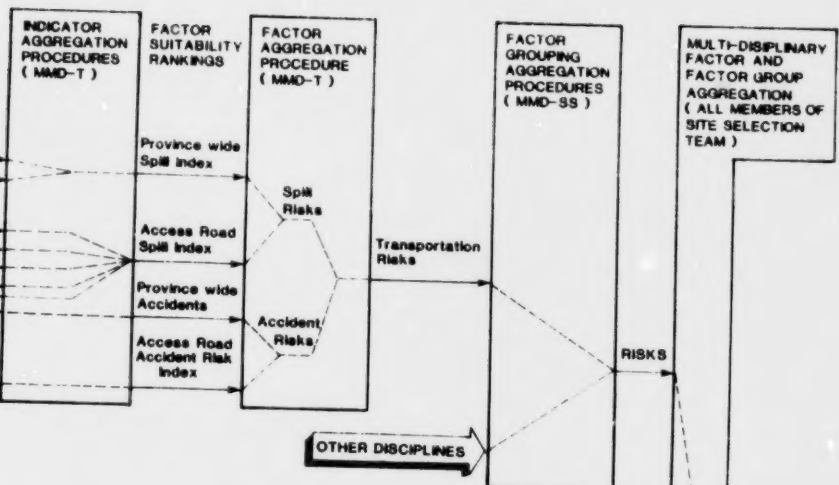
Following an examination of the indicator values, to determine if screening was necessary, it was found that all values would apply in the detailed comparative analysis. Therefore no indicators were screened for purposes of this analysis.

TRANSPORTATION INPUTS

RISKS

TRANSPORTATION RISK FACTOR GROUP

- Province wide Hazard based Spill Index
 - spill index due to accidents
 - spill index due to other causes
- Local and Regional Access Road Spill Risk
 - risk to road users
 - risk to population
 - risk to sensitive community feature
 - risk to surface water suitability
 - risk to sensitive hydrogeologic lands
- Province wide Accident Involvements
- Local and Regional Access Road Accident Risk
 - road user risk due to accidents



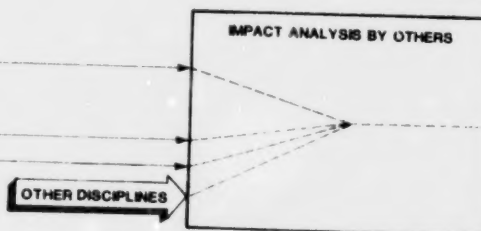
IMPACTS

SITE AND SITE VICINITY

Change in noise at and near site

ACCESS ROAD IMPACTS

Change in traffic on access roads
Change in noise on access roads



COSTS

ANNUAL TRANSPORT COSTS

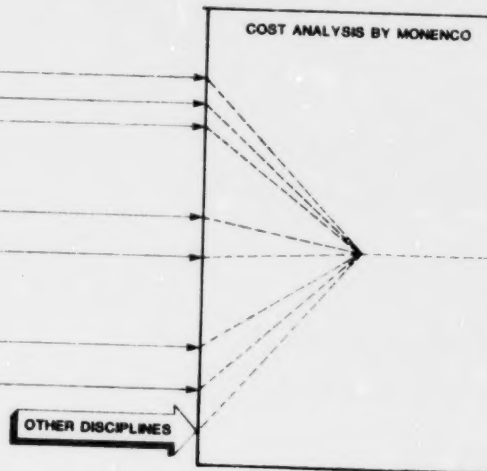
Cost for hauling special wastes
Cost for hauling additives/agents
Cost for hauling inter-site transfers

ROAD IMPROVEMENT COSTS

Cost for upgrading local road, improving geometrics, and implementation of site entrances
Cost of additional land required to accommodate improvements

RAIL ACCESS COSTS (sensitivity analysis)

Cost of constructing rail spur line between mainland and site plant
Cost of additional off-site required to implement rail lines



NOTES:

Factor and indicator titles have been paraphrased for brevity

5.4 SCALING OF INDICATORS

Indicator scaling was carried out in order to transform the transportation data from physical units to units of desirability. In the transportation analysis this was performed by dividing all site indicator values by the highest site value. As a result, the scaled value for the site with the highest indicator value would be 1.00, and all other scaled values would be expressed as a decimal percentage of this value. The following example illustrates this scaling technique:

<u>Site</u>	<u>Population Risk Index Value</u>	<u>Scaled Value</u>	<u>Rationale for Scaling Value</u>
LF-3C	13512.9	1.00	° maximum indicator value
LF-9C	11102.3	0.82	° 82% of maximum indicator value

The indicator values included under the factor 'Province-wide Hazard Based Spill Index', were not scaled during indicator aggregation. The two indicators, dealing with frequency of spills, have the same units of measurement and in their data form they also conveyed differences in frequency between motor vehicle accident related and non-motor vehicle accident related spills, which were important in interpreting the factors.

5.5 AGGREGATION OF INDICATORS

Indicator aggregation was carried out in instances where a factor contained more than one indicator. The objective was to derive a single factor suitability level based on the relative importance of each indicator associated with the factor.

5.5.1 Aggregation process

Two transportation factors contained more than one indicator: 'hazard based spill index on the province-wide access system' and 'risk due to spills on the local and regional access roads'. In

aggregating the indicators to these factors, each was given a specific weighting. These weights and the rationale are described in Table 8.6.

Equal weighting was applied to the two indicators of the 'province-wide hazard based spill index' factor because both the spills resulting from motor vehicle accident events and spills resulting from other events, can pose a potential risk to human health. The frequency of occurrence of each of these events is reflected in the unscaled indicator values.

The weights assigned to the indicators associated with 'risk due to spills on local and regional access roads' were derived from the risk rankings described in the report, M.M. Dillon Ltd., 1985, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Site Selection. The referenced report also contains the rationale for selecting these weightings.

The aggregated value for each factor was calculated by multiplying the scaled values by their respective indicator weights, and summing the products. This value was used to derive the factor suitability levels used in the comparison of siting options.

5.5.2 Factor suitability levels

Factor suitability levels are used so that the aggregated values for each factor can be transformed to a common basis for comparison purposes. The factor suitability levels for transportation risk ranges between 0, representing no constraints, to -6, representing a potential exclusionary factor. None of the transportation factors represent exclusionary constraints, therefore the range applied to the transportation analysis was between 0 and -5.

TABLE 8.6
OWMC PHASE 4A - TRANSPORTATION
INDICATOR RANKING AND WEIGHTING

<u>Factor</u>	<u>Indicator Ranking Order</u>	<u>Weight</u> ¹	<u>Rationale for Ranking</u>
1. Province-wide Hazard Based Spill Index	1st - Spills resulting from a motor vehicle accident event	1	° There is no specific data available to discern which type of spill would pose a greater hazard to human health and welfare.
	1st - Spills resulting from a non-motor vehicle accident event	1	
2. Risk due to Spills on Local and Regional Access Routes	1st - Risk to population	5	° The first three indicators are ranked higher because they represent direct risk to human health, the others are indirect pathways.
	2nd - Risk to road users	4	
	3rd - Risk to sensitive land uses	3	
	4th - Risk to surface water suitability	2	
	5th - Risk to sensitive hydrogeologic lands	1	° Rationale for weighting is described in the site selection report (Dillon, 1985).

NOTE: 1. Weight rationale documented in site selection report (Dillon, 1985).

The factor suitability level was derived from the aggregated factor value by dividing the aggregated value for a siting option by the maximum aggregated value across all the options, and multiplying by -5 to convert the value to the five-level scale. The following example illustrates this procedure:

<u>Site</u>	<u>Factor</u>	<u>Aggregated Factor Value</u>	<u>Suitability Level Calculation</u>
LF-9C	Risk due to spills on local and regional access roads	11.68	$\frac{11.78}{15.00} \times -5 = -3.93$

NOTE: 15.00 is the maximum value across all options.

Table 8.7 shows the aggregated values and suitability levels for the two factors related to the spill risks, and Table 8.8 shows the aggregation for the two factors related to accident involvement risk.

5.6 AGGREGATION OF FACTORS

Factor aggregation took place in much the same manner as indicator aggregation. Each factor was assigned a specific weighting, and the factor suitability levels were multiplied by these weights to obtain a factor score. By summing all the factor scores for each site, a value was obtained representing the transportation related risks of each siting option.

A 25% higher factor weighting was applied to the transportation factors dealing with the risks on the local and regional access road study areas than for the province-wide access road study areas. The rationale for this difference in study area weighting is as follows:

- OWMC generated traffic on the local and regional access route to each site forms a larger proportion of the traffic on these routes as opposed to the province-wide system;

TABLE 8.7
OWMC PHASE 4A - TRANSPORTATION
SCALING AND AGGREGATION OF HAZARD BASED SPILL RISK FACTORS AND INDICATORS

Factor	Indicator	Weight	Scaled Value and (Scaled Value x Weighting) for each Siting Option					
			LF-9C	LF-3C	LF-1E	PI-1N/ LF-4N	PI-13N/ LF-4N	PI-27E/ LF-1E
1. Risk due to Spills on Local and Regional Access Routes	a) Risk to Population	5	0.82 (4.11)	1.00 (5.00)	0.002 (0.01)	0.09 (0.44)	0.07 (0.37)	0.001 (0.01)
	b) Risk to Road Users	4	0.90 (3.60)	1.00 (4.00)	0.03 (0.12)	0.21 (0.84)	0.15 (0.62)	0.02 (0.08)
	c) Risk to Sensitive Uses	3	0.49 (1.47)	1.00 (3.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
	d) Surface Water Suitability	2	0.80 (1.60)	1.00 (2.00)	0.2 (0.40)	0.60 (1.20)	0.60 (1.20)	0.20 (0.40)
	e) Risk to Sensitive Hydrogeologic Lands	1	1.00 (1.00)	1.00 (1.00)	0 (0.00)	0.14 (0.14)	0.03 (0.03)	0 (0.00)
Aggregated Value for Factor:			11.78	15.00	0.53	2.62	2.22	0.49
Factor Suitability Level:			-3.9	-5.0	-0.2	-0.9	-0.7	-0.2
2. Province-wide Hazard Based Spill Index	a) Annual Accident Related Spills	1	3.226	3.226	5.43	1.967	1.967	5.43
	b) Annual Non-accident Related Spills	1	10.447	10.447	15.582	10.488	10.488	15.582
Aggregated Value for Factor:			13.673	13.673	21.012	12.455	12.455	21.012
Factor Suitability Level:			-3.3	-3.3	-5.00	-3.0	-3.0	-5.00

NOTES: 1. Indicator values for province-wide factor were not scaled in order to preserve differences in frequency of occurrence of the two types of spills. Therefore no "Scaled Value x Weighting" is shown.

TABLE 8.8

OWMC PHASE 4A - TRANSPORTATION
SCALING AND AGGREGATION OF ACCIDENT INVOLVEMENT RISK FACTORS AND INDICATORS

Factor	Indicator	Weight	Scaled Value (and Scaled Value x Weighting) for each Siting Option					
			LF-9C	LF-3C	LF-1E	LF-4N	PI-1N/ LF-4N	PI-13N/ LF-4N
1. Risk due to Accident Involvement on Local and Regional Access Roads	a) Risk to Road Users	1	0.92 (0.92)	1.00 (1.00)	0.03 (0.03)	0.21 (0.21)	0.20 (0.20)	0.03 (0.03)
	Factor Suitability Level:		-4.6	-5.0	-0.2	-1.1	-1.0	-0.2
2. Province-wide Annual Accident Involvement	a) Annual Accident Involvement	1	0.63 (0.63)	0.63 (0.63)	1.00 (1.00)	0.35 (0.35)	0.35 (0.35)	1.00 (1.00)
	Factor Suitability Level:		-3.2	-3.2	-5.0	-1.8	-1.8	-5.0

- ° a decision for locating a preferred site would increase the haulage of dangerous goods on the local and regional access system to a greater extent than it would on the province-wide system where many of these materials are already transported to other waste treatment facilities or landfills; and
- ° the potential transport risk on the local and regional system potentially exposes more receptors (except for road users) than occurs on the province-wide system, due to the greater spatial separation that exists between the location of a spill event and adjoining uses on the freeway system.

Therefore the following factor weightings were applied to the transportation risk factors:

<u>Factors</u>	<u>Weights</u>
° Province-wide hazard based spill index	8
° Risks due to spills on the local and regional access roads	10
° Province-wide accident involvements by OWMC generated vehicles	8
° Risks due to OWMC generated traffic accident involvements on local and regional access roads	10

In deriving the weighting values for the transportation risk factors it was also necessary to consider trade-offs with other risk, cost and impact factors. Documentation on these comparisons is contained in the site selection report (M.M. Dillon 1985).

6. APPLICATION OF FACTORS TO SITING OPTION COMPARISON

6.1 PURPOSE AND SCOPE

The evaluation process involves a comparison among the candidate siting options in order to identify major issues and trade-offs involved with the selection of one site over another. This process includes an overall ranking of the six options in terms of potential transportation risks.

This section outlines the transportation related trade-offs and issues and how they apply to the comparative process.

6.2 COMPARISON OF SITING OPTIONS

Table 8.9 contains the aggregated factor values for the spill related factors, the accident involvement related factors, and the total aggregation for transportation related risks.

It is noted that site ranking is the same for both the spills and accident involvement factors. However, it is also observed that there are trade-offs between the province-wide access system, which favour the northern sites, and the local and regional access road system, which favours the eastern sites. The sensitivity of the site rankings to the relative weighting of the local and regional access roads, and the province-wide routes is examined in Section 8 of this chapter.

In terms of the composite transportation factor analysis the six sites are ranked in the following order (from most preferred to least preferred):

PI-13N/LF-4N

PI-1N/LF-4N

PI-27E/LF-1E

LF-1E

LF-9C

LF-3C

Generally the siting options located within the same geographical area were ranked very close together. The differences, however, were greater when comparing the sites of different geographical areas. The differences between the northern sites and the eastern sites was not as large as the differences between the eastern sites and the central sites.

TABLE 8.9
OWMC PHASE 4A - TRANSPORTATION
AGGREGATION OF TRANSPORTATION RISK FACTORS

Factor	Weight	Factor Suitability (and Suitability x Weight) for each Siting Option					
		LF-9C	LF-3C	LF-1E	PI-1N/ LF-4N	PI-13N/ LF-4N	PI-27E/ LF-1E
1. Province-wide Hazard Based Spill Index	8	-3.3 (-26.4)	-3.3 (-26.4)	-5.0 (-40.0)	-3.0 (-24.0)	-3.0 (-24.0)	-5.0 (-40.0)
2. Spill Risks on Local and Regional Roads	10	-3.9 (-39.0)	-5.0 (-50.0)	-0.2 (-2.0)	-0.9 (-9.0)	-0.7 (-7.0)	-0.2 (-2.0)
Aggregated Value for Spill Factors:		-65.4	-76.4	-42.0	-33.0	-31.0	-42.0
Site Option Ranking:		5th	6th	3rd	2nd	1st	3rd
3. Province-wide Accident Involvements	8	-3.2 (-25.6)	-3.2 (-25.6)	-5.0 (-40.0)	-1.8 (-14.4)	-1.8 (-14.4)	-5.0 (-40.0)
4. Accident Involvement Risks on Local and Regional Roads	10	-4.6 (-46.0)	-5.0 (-50.0)	-0.2 (-2.0)	-1.1 (-11.0)	-1.0 (-10.0)	-0.2 (-2.0)
Aggregated Value for Accident Involvement Factors:		-71.6	-75.6	-42.0	-25.4	-24.4	-42.0
Site Option Ranking:		5th	6th	3rd	2nd	1st	3rd
Aggregated Value for all Factors:		-137.0	-152.0	-84.0	-58.4	-55.4	-84.0
Site Option Ranking:		5th	6th	3rd	2nd	1st	3rd

The sensitivity of the transportation site rankings to the use of rail, and partial solidification is examined in Section 8.4 of this chapter, using the rail data in Appendix N, the partial solidification data in Appendix O, and the combined rail and partial data in Appendix P, of the Transportation Technical Appendices.

The ranking of the candidate sites in terms of transportation risks is applied to the overall site selection process along with other factors representing risks, impacts, and cost. The overall preferred site(s), and the rationale for its selection, is documented in the site selection report (Dillon, 1985).

7. FREQUENCY OF SPECIAL WASTE SPILLS AND ACCIDENT INVOLVEMENTS WITH POTENTIAL FOR RISK TO HUMAN HEALTH

7.1 PURPOSE AND SCOPE

The transportation ranking of candidate sites has been based on the assumption that all in-transit spills and accidents involving OWMC generated vehicles will have a potential risk to human health. However, an analysis carried out by Environ Corporation in their 1985 report, Site Selection Process, Phase 4A: Selection of a Preferred Site(s) - Generic Risk Assessment, revealed that only 9% of the 300,000 tonnes per annum of special wastes to be hauled to the treatment facilities would have a potential for risk to human health via the air pathway in the event of a spill. Regarding accident involvements, the Ontario Ministry of Transportation and Communications' 1982 publication, Ontario Motor Vehicle Accident Facts, 1981, indicated that only 0.9% of all medium to heavy trucks involved in accidents for the years 1980 and 1981 resulted in a fatal accident, and 30% resulted in personal injury accidents.

Based on these findings M.M. Dillon - Transportation estimated the number of in-transit spills, and OWMC generated truck accident involvements which would result in a potential

hazard to human health. The information developed during this analysis provided input to the determination of relative weights to be applied to the risk factors in relation to the two study areas as discussed in the previous section.

7.2 FREQUENCY OF SPECIAL WASTE SPILLS WITH HUMAN HEALTH RISK POTENTIAL

7.2.1 Spill frequencies

The generic risk assessment (Environ, 1985) indicates that only 9% of the special wastes being carried to the OWMC treatment facility pose a potential risk to human health via the air pathway in the event of a spill. Tables 8.10 to 8.12 indicate the frequency of motor vehicle accident-related, and non-motor vehicle accident-related spills which may have a potential risk to human health. The three tables present frequency data for each of the following study areas: local and regional access roads, province-wide access system, and total transportation system, respectively, based on the calculated number of spills presented in Appendix K of the Transportation Technical Appendices.

The spills frequency data presented overstates the potential risk to human health in that:

- ° many of the spills would result in the release of very small quantities of hazardous waste as opposed to large quantity releases, and
- ° many of the spills would occur along routes and within areas where direct exposure to individuals is unlikely.

The calculated frequencies for the various study areas, therefore, represent a conservative assumption. This is consistent with the use of worst case events applied in the generic risk assessment (Environ, 1985).

The general approach employed was considered adequate for purposes of comparative analysis of all siting options. However, it is recommended that more detailed consideration be given to the likelihood of human exposure as a result of transportation events during Phase 4B.

TABLE 8.10
OWMC PHASE 4A - TRANSPORTATION
FREQUENCY OF SPECIAL WASTE SPILLS ON LOCAL AND
REGIONAL ACCESS ROADS WITH HUMAN HEALTH RISK POTENTIAL

<u>Siting Option</u>	Frequency of Human Health Threatening Special Waste Spills ^{1, 2} on Local and Regional Access Roads		
	<u>Motor Vehicle Accident-related Spills</u>	<u>Non-Motor Vehicle Accident-related Spills</u>	<u>Total All Types of Spills</u>
LF-9C	1 every 48.3 years	1 every 35.2 years	1 every 20.4 years
LF-3C	1 every 33.6 years	1 every 21.3 years	1 every 13.0 years
LF-1E	1 every 213.7 years	1 every 146.2 years	1 every 90.3 years
LF-1E/PI-27E	1 every 653.5 years	1 every 483.1 years	1 every 277.3 years
LF-4N/PI-1N	1 every 80.5 years	1 every 60.1 years	1 every 34.4 years
LF-4N/PI-13N	1 every 101.9 years	1 every 68.2 years	1 every 40.8 years

- NOTES: 1. Spill frequency calculation based on 9% of the 300 000 t/a of special wastes which has a potential for risk to human health via the air pathway (Environ 1985).
2. All frequency calculations based on year 2000 operation at which time the OWMC expects to process 300 000 t/a of special wastes (Monenco Phase 4A Engineering Report, 1985).

TABLE 8.11
OWMC PHASE 4A - TRANSPORTATION
FREQUENCY OF SPECIAL WASTE SPILLS ON PROVINCE-WIDE
ACCESS SYSTEM WITH HUMAN HEALTH RISK POTENTIAL

<u>Siting Option</u>	Frequency of Human Health Threatening Special Waste Spills ^{1, 2} on Province-wide Access System		
	<u>Motor Vehicle Accident-related Spills</u>	<u>Non-Motor Vehicle Accident-related Spills</u>	<u>Total All Types of Spills</u>
LF-9C	1 every 35.7 years	1 every 11.1 years	1 every 8.5 years
LF-3C	1 every 35.7 years	1 every 11.1 years	1 every 8.5 years
LF-1E	1 every 21.0 years	1 every 7.4 years	1 every 5.5 years
LF-1E/PI-27E	1 every 21.0 years	1 every 7.4 years	1 every 5.5 years
LF-4N/PI-1N	1 every 57.9 years	1 every 10.8 years	1 every 9.1 years
LF-4N/PI-13N	1 every 57.9 years	1 every 10.8 years	1 every 9.1 years

- NOTES: 1. Spill frequency calculation based on 9% of the 300 000 t/a of special wastes which has a potential for risk to human health via the air pathway (Environ 1985).
2. All frequency calculations based on year 2000 operation at which time the OWMC expects to process 300 000 t/a of special wastes (Monenco Phase 4A Engineering Report, 1985).

TABLE 8.12
OWMC PHASE 4A - TRANSPORTATION
FREQUENCY OF SPECIAL WASTE SPILLS ON TOTAL TRANSPORT
SYSTEM WITH HUMAN HEALTH RISK POTENTIAL

<u>Siting Option</u>	Frequency of Human Health Threatening Special Waste Spills ^{1, 2} on Total Transport System		
	<u>Motor Vehicle Accident-related Spills</u>	<u>Non-Motor Vehicle Accident-related Spills</u>	<u>Total All Types of Spills</u>
LF-9C	1 every 20.6 years	1 every 8.4 years	1 every 6.0 years
LF-3C	1 every 17.3 years	1 every 7.3 years	1 every 5.1 years
LF-1E	1 every 19.2 years	1 every 7.0 years	1 every 5.1 years
LF-1E/PI-27E	1 every 20.4 years	1 every 7.3 years	1 every 5.4 years
LF-4N/PI-1N	1 every 33.6 years	1 every 9.2 years	1 every 7.2 years
LF-4N/PI-13N	1 every 36.9 years	1 every 9.4 years	1 every 7.5 years

- NOTES: 1. Spill frequency calculation based on 9% of the 300 000 t/a of special wastes which has a potential for risk to human health via the air pathway (Environ 1985).
2. All frequency calculations based on year 2000 operation at which time the OWMC expects to process 300 000 t/a of special wastes (Monenco Phase 4A Engineering Report, 1985).

7.2.2 Discussion of results

The analysis indicates that for all candidate sites a spill posing a potential risk to human health (total for all types) is more likely to occur along the province-wide access system (1 every 5.5 to 9.1 years) than on the local and regional access system (1 every 13.0 to 277.8 years). On the local and regional access system non-motor vehicle accident-related spills (1 every 21.3 to 483.1 years) are more likely to occur than the accident-related spills (1 every 33.6 to 653.5 years).

On the total transport system the range in spill frequencies across the siting options is much smaller than for the other study areas (1 every 5.1 to 7.5 years), indicating that on a total system basis all candidate sites will produce approximately the same number of spills with potential for risk to human health.

Further to this observation, M.M. Dillon - Transportation engaged the services of StatPlan Associates to examine the statistical significance of the differences between the candidate sites in terms of the total spills for all commodities. Their results, presented in A Statistical Analysis of Variation in Transportation Risks for OWMC Candidate Sites, 1985, (see Appendix Q of the Transportation Technical Appendices), indicated that when spills of all categories are considered (between 2.0 and 2.8 spills annually), only the northern sites (2.0 to 2.2 spills annually) have a significantly lower number of spills than the sites in the other regional areas (2.5 to 2.8 spills annually). Consequently, there is no statistical difference between the spill frequencies calculated for the four sites in the Niagara Region.

When comparing the siting options in terms of spills posing a potential risk to human health, it was noted by StatPlan Associates that the differences between all the siting options were too small to discern any statistical difference.

7.3 FREQUENCY OF ACCIDENT INVOLVEMENTS WITH HUMAN HEALTH RISK POTENTIAL

7.3.1 Frequency of OWMC generated trucks involved in fatal or personal injury accidents

Research into the 1980-1981 Ontario Accident experience (MTC, 1982) has indicated that of all medium and heavy trucks involved in accidents, 0.9% have been fatal accidents, and 30% have been personal injury accidents. Tables 8.13 to 8.15 list the frequency of fatal, and personal injury accident involvements which can be expected by the OWMC generated trucks. These are the only accident involvements which pose a potential risk to human health. The tables present information for each of the following study areas: local and regional access roads, province-wide access systems, and total transport systems, respectively, based on the accident involvement data presented in Appendix K of the Transportation Technical Appendices.

7.3.2 Discussion of results

The analysis shows that the range of fatal accident involvements across all the sites for the total transportation system is 1 every 13.4 to 21.0 years. Considering accident involvements producing personal injury for the total transport system, the frequency would be 1.6 to 2.5 per annum. Here again there is a relatively narrow range between all siting options.

A statistical analysis of the total number of annual accident involvements for each siting option (Appendix Q of the Transportation Technical Appendices) indicated that only the northern sites, with 5.3 to 6.0 accident involvements annually, are significantly different from the other sites, with 7.1 to 8.3 accident involvements annually, at the 5% significant level. Thus, there is no statistical difference between the four sites in the Niagara Region, at the 5% significance level, in terms of accident involvement frequencies.

TABLE 8.13
OWMC PHASE 4A - TRANSPORTATION
FREQUENCY OF ACCIDENT INVOLVEMENTS ON LOCAL AND
REGIONAL ACCESS ROADS WITH HUMAN HEALTH RISK POTENTIAL

Frequency of Human Health Threatening Accident Involvements ¹ on Local and Regional Access Roads			
<u>Siting Option</u>	<u>Fatal Accident Involvement</u>	<u>Personal Injury Accident Involvement</u>	<u>Total Fatal and Injury Accident Involvement</u>
LF-9C	1 every 40.1 years	1 every 1.2 years	1 every 1.2 years
LF-3C	1 every 28.1 years	1 every 0.8 years	1 every 0.8 years
LF-1E	1 every 185.5 years	1 every 5.6 years	1 every 5.4 years
LF-1E/PI-27E	1 every 244.2 years	1 every 7.3 years	1 every 7.1 years
LF-4N/PI-1N	1 every 39.0 years	1 every 1.2 years	1 every 1.1 years
LF-4N/PI-13N	1 every 31.3 years	1 every 0.9 years	1 every 0.9 years

NOTE: 1. Accident involvement frequency calculations are based on the year 2000 operation at which time the OWMC expects to process 300 000 t/a of special wastes (Monenco Phase 4A Engineering Report, 1985); it also included two-way travel for all OWMC generated transport of special wastes, additives and reagents, and inter-site transfer movements when these apply.

TABLE 8.14
OWMC PHASE 4A - TRANSPORTATION
FREQUENCY OF ACCIDENT INVOLVEMENTS ON PROVINCE-WIDE
ACCESS SYSTEM WITH HUMAN HEALTH RISK POTENTIAL

Frequency of Human Health Threatening Accident Involvements ¹ on Province-wide Access System			
<u>Siting Option</u>	<u>Fatal Accident Involvement</u>	<u>Personal Injury Accident Involvement</u>	<u>Total Fatal and Injury Accident Involvement</u>
LF-9C	1 every 25.5 years	1.3 per year	1.4 per year
LF-3C	1 every 25.5 years	1.3 per year	1.4 per year
LF-1E	1 every 16.1 years	2.1 per year	2.1 per year
LF-1E/PI-27E	1 every 16.1 years	2.1 per year	2.1 per year
LF-4N/PI-1N	1 every 45.5 years	1 every 1.4 years	0.77 per year
LF-4N/PI-13N	1 every 45.5 years	1 every 1.4 years	0.77 per year

NOTE: 1. Accident involvement frequency calculations are based on the year 2000 operation at which time the OWMC expects to process 300 000 t/a of special wastes (Monenco Phase 4A Engineering Report, 1985); it also included two-way travel for all OWMC generated transport of special wastes, additives and reagents, and inter-site transfer movements when these apply.

TABLE 8.15
OWMC PHASE 4A - TRANSPORTATION
FREQUENCY OF ACCIDENT INVOLVEMENTS ON TOTAL TRANSPORT
SYSTEM WITH HUMAN HEALTH RISK POTENTIAL

<u>Siting Option</u>	<u>Frequency of Human Health Threatening Accident Involvements¹ on Total Transport System</u>		
	<u>Fatal Accident Involvement</u>	<u>Personal Injury Accident Involvement</u>	<u>Total Fatal and Injury Accident Involvement</u>
LF-9C	1 every 15.6 years	2.1 per year	2.2 per year
LF-3C	1 every 13.4 years	2.5 per year	2.6 per year
LF-1E	1 every 14.8 years	2.3 per year	2.3 per year
LF-1E/PI-27E	1 every 15.1 years	2.2 per year	2.3 per year
LF-4N/PI-1N	1 every 21.0 years	1.6 per year	1.6 per year
LF-4N/PI-13N	1 every 18.5 years	1.8 per year	1.8 per year

NOTE: 1. Accident involvement frequency calculations are based on the year 2000 operation at which time the OWMC expects to process 300 000 t/a of special wastes (Monenco Phase 4A Engineering Report, 1985); it also included two-way travel for all OWMC generated transport of special wastes, additives and reagents, and inter-site transfer movements when these apply.

It was also noted by StatPlan Associates that the differences between the siting options in terms of fatal or personal injury accidents are too small to be statistically significant, consequently all sites have statistically the same potential for accident involvements which would pose a hazard to human health.

8. SENSITIVITY ANALYSES OF TRANSPORTATION CONCLUSIONS

8.1 PURPOSE AND SCOPE

The purpose of the sensitivity analyses is to examine the transportation results and determine how the ranking of the siting options may change in each of the following situations:

- ° changing the weights applied to the province-wide, and local and regional access road factors,
- ° deletion of surface water and hydrogeologic receptors,
- ° deletion of all local and regional access road receptor data,
- ° use of rail for hauling additives and reagents to the site,
- ° use of the partial solidification treatment process,
- ° combined use of rail and partial solidification treatment process.

The sensitivity analyses utilize the transportation data developed during the Phase 4A site selection process. Information concerning the use of rail, partial solidification, and the combined use of both rail and partial solidification is contained in Appendices N, O and P in the Transportation Technical Appendices.

The objective of these sensitivity analyses is to determine how each component of the transportation analysis contributed to the final ranking of the six siting options in terms of transportation risks.

8.2 SENSITIVITY OF PROVINCE-WIDE AND LOCAL AND REGIONAL ACCESS ROAD FACTOR WEIGHTING TO RANKING OF SITING OPTIONS

The transportation analysis showed that the ranking of the siting options differed for the province-wide, and local and regional access routes study areas. For the province-wide factors the Milton sites (PI-13N/LF-4N, and PI-1N/LF-4N) were the highest ranked followed by the West Lincoln sites (LF-9C, and LF-3C) and Niagara sites (PI-27E/LF-1E, LF-1E). In terms of the local and regional access road factors the Niagara sites were preferred next to the Milton sites and followed by the West Lincoln sites. Therefore, in aggregating the factor values it is important to consider the weighting to be applied to each of these study areas.

This subsection discusses the rationale for weighting the local and regional access road data higher than the province-wide data, and the effect of a change in weighting of the factor rankings.

8.2.1 Rationale for the relative weighting of local and regional access road factors and province-wide factors

The two study areas in which the transportation factors were applied contain different characteristics which determine the differences between the two study areas in terms of transportation risks. Table 8.16 lists the characteristics of the province-wide study area which contribute to a higher transportation risk than the other study areas. Table 8.17 lists characteristics of the local and regional access road study area which produce higher transportation risks than the province-wide study area.

In examining the various arguments presented in these two tables, it was concluded that the local and regional access road system has a greater potential for transportation risks than the province-wide system. The reasons for this conclusion are as follows:

TABLE 8.16
OWMC PHASE 4A - TRANSPORTATION
CHARACTERISTICS OF THE PROVINCE-WIDE STUDY AREA
WHICH PRODUCE POTENTIALLY HIGHER TRANSPORTATION RISKS
THAN THE LOCAL AND REGIONAL ACCESS ROUTE STUDY AREA

<u>Province-wide Study Area Characteristics Producing Greater Potential Risks</u>	<u>Rationale</u>
° Higher operating speeds producing a greater severity of accidents	° Operating speed on freeways in the province-wide study area are generally higher than the speeds along the local and regional access roads; therefore, certain types of accidents may be more severe when they occur on a freeway.
° More road users	° An accident involvement or spill on the province-wide system may affect more road users than if it occurred on the local and regional access system. ° the 1983 Annual Average Daily Traffic (AADT) on the freeway portion of the province-wide system ranges between 14,800 on the QEW in Niagara, to 238,600 on Highway 401 in Toronto; while the 1983 AADT on the local and regional access system ranges between 35 on Krick Road near site LF-3C to a high of 8,200 on Highway 25 near site PI-1N.
° A larger portion of the total system	° Annual province-wide vehicle-kilometres of travel ranges between 1.3 to 2.0 million; while travel on local and regional access roads ranges between 65,163 to 605,430 vehicle-kilometres.
° More people across the whole system adjacent to the roadways	° A large portion of the province-wide system passes through major population centres in Southern Ontario.
° Contains a portion of non-freeway travel on routes similar to the access roads	° Between 338,000 to 351,000 vehicle-kilometres of the province-wide system is composed of non-freeway routes which may be similar to the local and regional access roads; this constitutes about 17% to 27% of the total system vehicle-kilometres.

TABLE 8.17
 OWMC PHASE 4A - TRANSPORTATION
 CHARACTERISTICS OF THE LOCAL AND REGIONAL STUDY
 AREA WHICH PRODUCE POTENTIALLY HIGHER TRANSPORTATION
 RISKS THAN THE PROVINCE-WIDE STUDY AREA

<u>Local and Regional Access Road Characteristics Producing Greater Potential Risks</u>	<u>Rationale</u>
° Greater level of pedestrian activity	° Majority of the province-wide system is composed of freeways where no pedestrian activity takes place; portions of the local and regional access routes travel through population centres where pedestrian activity can take place.
° Greater level of school bus and agricultural vehicle movements	° Local and regional routes are shared to some extent with school bus and agricultural vehicles; the majority of the province-wide system has no agricultural vehicles, and no school bus loadings/unloadings.
° Lower design standards	° Due to the lower traffic volumes on the local and regional routes, the structural and geometric standards are not as high as the majority of the province-wide system travel.
° Traffic operations (i.e. intersections, individual roadways) leading to greater potential for severe accidents	° The majority (72% - 82%) of the province-wide travel (veh-km) is along freeways which contain a minimum of traffic conflict situations such as undivided roadways, and at grade intersections.
° More people, and community and recreational features closer to the route	° The majority of the province-wide travel is along freeways which have a larger right-of-way than the local and regional access roads; therefore, population and land uses may be farther removed from the scene of an accident or spill on the province-wide system than on the local and regional access system.

TABLE 8.17
OWMC PHASE 4A - TRANSPORTATION
CHARACTERISTICS OF THE LOCAL AND REGIONAL STUDY
AREA WHICH PRODUCE POTENTIALLY HIGHER TRANSPORTATION
RISKS THAN THE PROVINCE-WIDE STUDY AREA
(Continued)

<u>Local and Regional Access Road Characteristics Producing Greater Potential Risks</u>	<u>Rationale</u>
° Hazardous chemicals, in general, and special wastes, in particular, already use the province-wide system; OWMC facility may improve the province-wide system, but not the local and regional access system ° The use of the province-wide system is more consistent with the function of these roads	° OWMC generated traffic will pose a relatively small component of hazardous chemicals now being hauled on the province-wide system; whereas the presence of OWMC vehicles on the local and regional routes tends to represent a relatively larger proportion of the total traffic. ° The freeway system which is used for the majority of the province-wide travel has been designated as the main inter-regional transport system which is designed to carry large volumes of trucks safely over long distances.

- ° Although a proportion of the province-wide system travel (17% to 27%) occurs on roads which are assumed to have similar characteristics to those of the local and regional roads (these routes generally connect a waste source municipal generation area to the freeway system) and would be used to approximately the same extent regardless of the siting option selected; therefore differences between siting options generally are with respect to the amount of freeway travel. (Note: Province-wide system travel data is contained in Appendix K of the Transportation Technical Appendices).
- ° Certain types of accidents will likely be more severe on a freeway system than on non-freeway routes due to the higher operating speed; however, the geometric characteristics and type of traffic operations on local and regional access routes are such that they could have a greater potential for specific accident types than would occur on a freeway system (i.e. head-on collisions, intersectional collision, fixed objects, etc.).
- ° Although there are expected to be a greater number of road users on the province-wide system, the OWMC generated traffic volume composes a smaller proportion of the total traffic along the province-wide route than on the local and regional roads.
- ° Population centres encountered may be larger along the province-wide system, however they are generally farther removed from the location of a potential spill or accident and are better able to provide emergency response in the event of a mishap than the smaller population centres along the local and regional access routes. In addition, evacuation of the affected areas is assisted due to the fact that no land use or population centres are directly accessed by the freeway system and therefore unaffected routes may be used to evacuate the area.
- ° Special wastes are known to be moving over a wide variety of roadways today all over the province from producer plants to treatment sites in Sarnia, Blainville, Quebec, New York State, Michigan, and to a variety of municipal landfills and transfer/consolidation stations in Ontario.
- ° As a result, spill and accident involvements are now occurring possibly in even greater numbers than will occur with an OWMC facility located in proximity of the 'golden horseshoe' wherein an estimated 70% of Ontario's wastes are generated.
- ° It is therefore reasonable to assume that with an OWMC treatment facility the current situation would be ameliorated and this would reduce the frequency of these adverse events on the province-wide system.

- ° Based on this reasoning, the OWMC treatment facility located within the 'golden horseshoe' could actually improve the province-wide operation; however, there is no doubt that it would adversely affect the conditions on the local and regional system component where it is unlikely that a significant amount of waste now moves.

8.2.2 Sensitivity testing of relative weighting of province-wide and local and regional access study areas

The transportation analysis showed that the eastern siting options, LF-1E and LF-1E/PI-27E, were ranked the highest in terms of local and regional access road risks, while the central sites, LF-9C and LF-3C, were ranked the lowest. The province-wide factors favoured the northern sites, PI-1N/LF-4N and PI-13N/LF-4N, and the eastern sites were the lowest ranked. When the factors were combined the northern sites were favoured, while the central sites were the lowest ranked.

In examining the sensitivity of these rankings to the weightings applied to the different study areas it was noted that by using a higher weighting for the province-wide factor, the central sites could be ranked higher than the eastern sites. Also by weighting the local and regional factors higher the eastern sites could be ranked higher than the northern sites, but no combination of weights would rank the central sites higher than the northern sites. However, these altered factor weightings would not realistically reflect the relative importance of these factors.

In order for site LF-9C, the highest ranked central site, to be equal or better than the eastern sites, the weighting of the province-wide access road spill factor would need to be 2.2 times that of the local and regional access road spill factor (22 vs. 10). The province-wide access road accident factor would need to be 2.4 times larger than the local and regional access road factor (24 vs. 10). Such weightings do not realistically reflect the importance of the relative risks of in-transit spills or accidents

for these two study areas as discussed in Section 8.2.1. Therefore it is concluded that the relative ranking of the central and eastern sites, as described in the basic transportation analysis, is a realistic representation of their relative spill risks.

The ranking of the eastern sites in relation to site option LF-4N/PI-1N, the lowest ranked northern siting option, will change as the relative importance of risks on the local and regional access roads increases in comparison with the province-wide access road spills and accident involvements. When the in-transit spill risk on local and regional access roads importance is 2.9 times that of the province-wide spill risk, the eastern sites will be equal to the northern sites (23.2 vs. 8). Similarly, the eastern sites would be ranked equivalent to the northern sites in terms of accident involvement factors if the local and regional access road risk factors were ranked 3.6 times that of the province-wide factors (28.8 vs. 8). As stated in Section 8.2.1, such weightings would not realistically represent the importance of the relative risk within these study areas. Therefore, it was concluded that the rankings derived from the basic transportation analysis are realistic representations of the relative accident risk.

Table 8.18 summarizes the results of the sensitivity analyses of the weighting of the transportation factors. The table illustrates the factor weightings which would need to be applied to one factor in order to alter the ranking and still maintain the relative importance of the other transportation risk factors in the total potential risk analysis.

8.3 SENSITIVITY OF SITING OPTION RANKINGS TO LOCAL AND REGIONAL ACCESS ROAD RISK RECEPTORS AND PATHWAYS

The transportation analysis considered the potential risk of spills and accident involvements to the population and environment along the local and regional access routes. The objective of the

TABLE 8.18
OWMC PHASE 4A - TRANSPORTATION
SENSITIVITY OF THE WEIGHTING OF PROVINCE-WIDE AND LOCAL AND
REGIONAL TRANSPORTATION RISK FACTORS ON SITING OPTION RANKINGS

<u>Sensitivity Analysis Cases</u>	<u>Risk Factors</u>	<u>Weighting of Transportation Risk Study Areas</u>		
		<u>Province- wide Access Roads</u>	<u>Local and Regional Access Roads</u>	<u>Effect on Site Ranking</u>
° Base case weights applied in transportation aggregation of risk factors:	. spills	8	10	1st - Northern Sites
	. accidents	8	10	2nd - Eastern Sites
				3rd - Central Sites
° Increase importance of province-wide access road factor relative to local and regional access roads:				1st - Northern Sites
	. spills	>22	10	2nd - Central Sites
	. accidents	>24	10	3rd - Eastern Sites
° Increase importance of local and regional access roads factors relative to province-wide access roads:				1st - Eastern Sites
	. spills	8	>32.2	2nd - Northern Sites
	. accidents	8	>28.8	3rd - Central Sites

sensitivity analyses is to determine what effect these potential risks have on the ranking of the siting options. Two sensitivity analyses were carried out to compare the base case rankings to the rankings produced through each of the following:

- ° excluding indirect pathway receptors (i.e. surface water suitability, and hydrogeologic sensitive lands),
- ° excluding all local and regional access road receptors.

8.3.1 Sensitivity of transportation risk rankings to elimination of indirect risk pathways on local and regional roads

Two indirect pathways were considered with the potential transportation risks on the local and regional roads:

- ° risk to surface water suitability due to spills, and
- ° risk to sensitive hydrogeologic lands due to spills.

Both of these areas of potential risks received relatively low ranking in the transportation analysis (see Table 8.7).

Table 8.19 shows how the total aggregated factor scores (includes all transport factors) change when indirect pathways were removed from the analysis. The relative ranking of the sites did not change and factor scores tended to improve only slightly in relation to site LF-3C. This indicates that indirect transportation risk pathways were only a minor contributor to the relative ranking of sites and did not exhibit as great a difference between sites as did some of the other potential risk indicators.

8.3.2 Sensitivity of transportation risk rankings to the elimination of all local and regional access road risk receptors

In addition to the indirect risk pathways described in Section 8.3.2, there were four other risk receptors considered in the transportation analysis along local and regional access roads:

TABLE 8.19
OWMC PHASE 4A - TRANSPORTATION
SENSITIVITY OF TRANSPORTATION RANKINGS TO INDIRECT
RISK PATHWAYS ON LOCAL AND REGIONAL ACCESS ROADS

<u>Total Aggregated Factor Values²</u>				
<u>Siting Options</u>	<u>Including Indirect Pathways¹</u>	<u>Rank</u>	<u>Without Indirect Pathways</u>	<u>Rank</u>
LF-9C	-137.0	5th	-133.0	5th
LF-3C	-152.0	6th	-152.0	6th
LF-1E	-84.0	3rd	-82.5	4th
PI-1N/LF-7N	-58.4	2nd	-54.4	2nd
PI-13N/LF-4N	-55.4	1st	-52.4	1st
PI-27E/LF-1E	-84.0	3rd	-82.3	3rd

NOTES: 1. Values extracted from Table 8.9

2. The values noted in this table are based upon the total access system and include values for potential spill and accident involvement risks.

- ° risk to road users due to spills,
- ° risk to population due to spills,
- ° risk to sensitive community and recreational features due to spills, and
- ° risk to road users due to accident involvements.

This sensitivity analysis examines the importance of these receptors to the transportation ranking of the siting options by using only the hazard based spill index, and annual accident involvements to represent the local and regional access road transportation risks.

Table 8.20 presents a comparison of the spills and accident aggregated factor values and rankings for the base case (with receptors), to the aggregated factor values and rankings derived when the receptors are excluded from the local and regional access road factors. In terms of spills, there are slight changes in site rankings, however, there are major changes to ranking with respect to the accident involvement factors.

When the receptor data are excluded in the aggregation of the spill factors the spread among the siting options is greatly reduced. As a result the Milton and Niagara sites are ranked very close together with site PI-27E/LF-1E ranked behind site PI-13N/LF-4N, and ahead of site PI-1N/LF-4N and LF-1E. Site LF-9C also improves considerably against the Niagara and Milton sites, while site LF-3C remains the lowest ranked site. The results for the spill factors indicate that local and regional road receptor data have a great deal of importance in determining the rank order of the siting options.

When no receptor data are applied with the accident involvement data for local and regional access roads, the spread among sites is greatly reduced and the ranking of options changes

TABLE 8.20
OWMC PHASE 4A - TRANSPORTATION
SENSITIVITY OF TRANSPORTATION RANKINGS TO LOCAL
AND REGIONAL ACCESS ROAD RISK RECEPTORS

Siting Options	Aggregated Spill Factor Values ²				Aggregated Accident Involvement Factor Values ²			
	With Receptors ¹	Rank	Without Receptors	Rank	With Receptors ¹	Rank	Without Receptors	Rank
LF-9C	-65.4	5th	-58.4	5th	-71.6	5th	-60.6	4th
LF-3C	-76.4	6th	-76.4	6th	-75.6	6th	-75.6	6th
LF-1E	-42.0	3rd	-48.0	4th	-42.0	3rd	-47.5	2nd
PI-1N/LF-4N	-33.0	2nd	-44.0	3rd	-25.4	2nd	-50.4	3rd
PI-13N/LF-4N	-31.0	1st	-42.0	1st	-24.4	1st	-61.9	5th
PI-27E/LF-1E	-42.0	3rd	-43.0	2nd	-42.0	3rd	-46.0	1st

NOTES: 1. Values extracted from Table 8.9

2. The values noted in this table are based upon the total access system.

markedly. The Niagara sites are ranked the highest, and site LF-9C ranks fourth behind site PI-1N/LF-4N, and ahead of LF-3C. These results indicate that the local and regional access road receptor data plays a major part in the siting option transportation ranking.

8.4 SENSITIVITY OF TRANSPORTATION RANKING TO THE USE OF RAIL AND/OR PARTIAL SOLIDIFICATION

This subsection documents the results of an investigation into the use of rail and/or partial solidification to reduce the potential transportation risks associated with the OWMC generated traffic. The analysis concludes that although the potential risks can be reduced through these measures, there is no significant change to the relative ranking of the siting options.

Appendices N through P of the Transportation Technical Appendices contain the background data used in the analyses described herein.

8.4.1 Description of the use of rail haulage

The use of the rail mode for transporting certain commodities to the candidate sites can reduce the risks associated with spills and accident involvements by reducing the number of trucks on the total access route system. The analysis of rail options in Chapter 5 indicates that only five of the six remaining siting options are served by a suitable rail option because rail service to site PI-13N is not deemed desirable due to severe land use and environmental conflicts, and high construction costs.

Rail haulage of materials is possible only in instances where the material to be hauled can be transported in sufficient quantity to warrant the use of large capacity rail cars. Most of the additives and reagents are required in sufficient quantities

that rail can be used as an alternative mode for bringing these materials to the site. Certain of the low volume additives and reagent commodities, however, will still need to be hauled by road to each site. For most siting options, where rail could be used for hauling additives and reagents, the number of truck haul vehicles carrying additives and reagents is reduced by about 99% through the use of rail haulage. This reduction in road haulage results in a reduction in the estimated number of spills and accident involvements along the access roads leading to reduced transportation risks.

It is anticipated that there will be some risk associated with the haulage of additives and reagents by rail. However, as shown in Table 8.21, the annual number of shipments and the distance from the main line is much less for rail than for road haul. Therefore, these risks will be relatively small.

This report does not examine the total cost implication of rail haulage, however it is estimated that the cost of the rail infrastructure and right-of-way required will range between \$390,000 to \$2,140,000 (see Table 5.19). The rail transportation haulage costs have not been examined during this phase. The preliminary indication is that the costs for rail will be similar to that of road haulage. There would also be additional capital costs for on-site storage of the rail cars and the bulk storage of hauled materials.

8.4.2 Effect of the use of rail on the transportation ranking of siting options

Although the use of rail reduces the potential transportation risks, the ranking of the siting options changes only slightly when the use of rail is considered; however, the range of values across the options is reduced. The transportation ranking of the siting options, from most preferred to least preferred, for rail usage is as follows:

TABLE 8.21
OWMC PHASE 4A TRANSPORTATION

COMPARISON OF ROAD AND RAIL
MODES FOR TRANSPORTING
PROCESS ADDITIVES AND REAGENTS¹

	<u>Primary Rail Mode</u>	<u>All By Road Mode</u>
Annual Shipments:	969 rail cars and 35 trucks per year	2,634 trucks per year
Distance to main line or 400-series highway:	0.4 to 2.9 km	3.9 to 32 km
Size of R-O-W:	18.3 m	20 to 37 m

NOTES: 1. Based on annual quantities of additives and reagents necessary to process 300,000 tonnes per annum of special wastes.

PI-1N/LF-4N

PI-13N/LF-4N (no rail service; see Section 8 4.1)

PI-27E/LF-1E

LF-1E

LF-9C

LF-3C

Siting option PI-1N/LF-4N surpasses siting option PI-13N/LF-4N when rail is considered because rail access was not deemed desirable for the PI-13N/LF-4N siting option.

The aggregated factor values were reduced through the use of rail reflecting the reduced potential transportation risk. The

aggregated factor value at each siting option was reduced by between 9.3% (for PI-1N/LF-4N) to 13.1% (for PI-27E/LF-1E), therefore the relative ranking of the siting option remains similar to the base case.

The transportation data and the factor/indicator scaling and aggregation is contained in Appendix N of the Transportation Technical Appendices.

8.4.3 Description of the use of partial solidification

This modified waste treatment process will reduce the transportation requirements at all candidate siting options. The partial solidification process reduces the amount of additives and reagents required at all sites, and inter-site transfer movements required at partially integrated siting options. Consequently, the risks associated with transportation are reduced.

A more detailed description of the transportation components of the partial solidification process is contained in Appendix M. Table 8.22 presents a comparison of road transport vehicle requirements for the two process methods. With a 6.4% to 24.2% reduction in the total number of transport vehicles required, the transportation risks along the access roads would also be reduced by use of the partial solidification process.

8.4.4 Effect of the use of partial solidification on transportation ranking of siting options

The partial solidification process is a similar process to the total solidification process with the exception that the partial solidification process uses an effluent disposal option to reduce the quantity of solidified material to be placed in the landfill.

TABLE 8.22
OWMC PHASE 4A TRANSPORTATION

COMPARISON OF VEHICLE TRANSPORT REQUIREMENTS FOR
TOTAL AND PARTIAL SOLIDIFICATION

<u>MATERIAL</u>	<u>ANNUAL NUMBER OF VEHICLES REQUIRED (ONE-WAY)¹</u>		<u>% Change in No. of Vehicles</u>
	<u>Total Solidification</u>	<u>Partial Solidification</u>	
Special Wastes	19,546 to 19,552	19,546 to 19,552	0
Additives/Reagents	2,634	1,222	-53.6
Intersite Transfers	<u>14,274</u>	<u>6,824</u>	<u>-52.2</u>
TOTAL (maximum):			
Integrated Sites	22,186	20,774	- 6.4
Partially Integrated Sites	36,454	27,598	-24.2

NOTES: 1. Annual vehicle requirements are based upon the year when 300,000 tonnes/ annum of wastes are received and the additives and reagents required to treat this quantity for the options of total solidification, and partial solidification.

The effect is a reduction in the quantities of additives and reagents required at the site, and the number of intersite truck movements between the solidification plant and the landfill for the partially integrated siting options.

In reducing the truck traffic generated by the sites, there is a corresponding reduction in potential risks to human health and the environment due to spills and accident involvements. However, the relative ranking of the sites remains unchanged from that of the base case. The transportation ranking of the siting options, from most preferred to least preferred, for partial solidification is as follows:

PI-13N/LF-4N

PI-IN/LF-4N

PI-27E/LF-1E

LF-1E

LF-9C

LF-3C

The aggregated factor values were reduced through the use of partial solidification, but not as far reduced as for the use of rail. The values at each siting option was reduced by between 5.8% (for LF-3C) to 7.1% (for PI-27E/LF-1E), therefore the relative ranking of the siting options did not change.

The transportation data and factor/indicator aggregation are documented in Appendix O of the Transportation Technical Appendices.

8.4.5 Use of partial solidification and rail

The combined use of partial solidification and rail reduces the potential transportation risks by reducing the amount of OWMC generated traffic along the province-wide and preferred access route to and between the candidate sites. Partially integrated siting options benefit the most from the combined use of partial solidification and rail because the transfer movements are reduced through the partial solidification process, and the additive and reagent movements are reduced by both the use of rail and partial solidification. There are no transfer movements required at the integrated sites, therefore only the effect of reduced additives and reagents will benefit these sites.

Although potential risks are reduced through the combined use of rail and partial solidification, the ranking of the siting options does not change from the base case. The transportation ranking of the siting options, from most preferred to ~~least~~ preferred is as follows:

PI-13N/LF-4N (no rail service; see Section 8.4.1)
PI-1N/LF-4N
PI-27E/LF-1E
LF-1E
LF-9C
LF-3C

Even though rail access was not viewed as desirable for siting option PI-13N/LF-4N, this siting option was ranked only marginally superior to PI-1N/LF-4N.

The aggregated factor values were reduced through the combined use of rail and partial solidification at a similar rate for all siting options except PI-13N/LF-4N where rail access is

not desirable. At PI-13N/LF-4N the aggregated value was reduced by 6.5%. At all other siting options the value was reduced by between 11.2% (LF-3C) to 13.5% (PI-27E/LF-1E). Since the reduction was similar for all siting options, there was no change in the relative ranking of the siting options.

Appendix P of the Transportation Technical Appendices documents the transportation data and factor/indicator aggregation information which were applied to this sensitivity analysis.

9. CONCLUSIONS

This chapter has documented the transportation analyses leading to the ranking of the six candidate siting options, and has also discussed this ranking with respect to potential risk to human health due to transportation, and the sensitivity of the ranking to the relative importance of the factor weights, local and regional access road risk receptors, and the use of rail and partial solidification. The following conclusions have been drawn from these analyses:

1. The application of the transportation risk factors to the site selection process has produced the following ranking of the candidate siting options, in order, from the most preferred to least preferred:

- PI-13N/LF-4N
- PI-1N/LF-4N
- PI-27E/LF-1E
- LF-1E
- LF-9C
- LF-3C

The potential transportation risks are very similar for siting options within the same geographical area (i.e. Milton, West Lincoln, Niagara Falls); however, difference between geographical areas are more significant. The difference between the Milton sites and the Niagara Falls sites is not as large as the differences between the Niagara Falls and West Lincoln sites.

2. In developing these rankings it has been demonstrated that although the rankings are sensitive to the relative importance of the local and regional access roads factor, the rank order of the sites would not be altered unless there was a very significant shift in the weights applied to these two factors. Such a change would not realistically reflect the relative importance of these factors with respect to the other risk factors applied.
3. The potential risk to human health as a result of in-transit spills, or accident involvements along the entire transport system, is estimated to be very small with very little difference among the options. It was estimated that there would only be one spill every 5.1 to 7.5 years which could affect human health (estimated to be 9% of the special waste spills); one accident involvement every 13.4 to 21.0 years would be a fatal accident (estimated to be 0.9% of all accident involvements); and between 1.6 and 2.5 accident involvements per year which would result in personal injury accidents (estimated to be 30% of all accident involvements).
4. Although the transportation analysis indicates a relative order of preference for the siting options, a statistical analysis of the estimated number of spills (all types) and accident involvements on the total transport system, with the facility operating at maximum capacity, revealed that the northern sites have a statistically significant lower number

of estimated spills (2.0 to 2.2 spills annually), and accident involvements (5.3 to 6.0 accident involvements annually) than those of the central and eastern sites (2.5 to 2.8 annual spills; 7.1 to 8.3 annual accident involvements). However, there is no statistical difference between the eastern and central sites in terms of the total estimated spills and accident involvements. Considering this conclusion, the ranking of these four sites largely reflects the preference in terms of their differences on local and regional access road potential risks.

5. An investigation into the sensitivity of the site rankings to the receptor data on the local and regional access roads, indicated that the results are relatively insensitive to the indirect risk pathways which include surface water suitability and sensitive hydrogeologic lands; however, the rankings are sensitive to the other direct risk receptors. It was concluded that the differences in potential risks to population, road users and sensitive land uses along the local and regional access routes have largely determined the relative ranking of the siting options.
6. The use of rail for hauling additives and reagents to the siting options reduces the potential transportation risk for all sites where rail access is desirable; however, the use of rail does not alter the relative ranking of siting options.
7. Partial solidification also reduces potential transportation risks; however, it does not alter siting option ranking.
8. The combined use of rail and partial solidification reduces transportation risks at partially integrated siting options to a larger degree than integrated option; however, it does not affect the relative ranking of the siting option.

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